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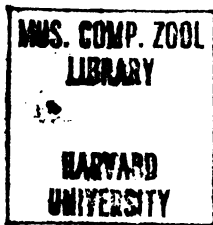
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THE
GLACIAL EPOCH
AND THE
NOACHIAN DELUGE

BY
HERBERT W. MAGOUN, Ph.D.

SPECIAL EDITION
FOR Y. M. C. A. MEN

CAMBRIDGE
1910



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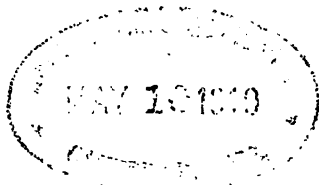
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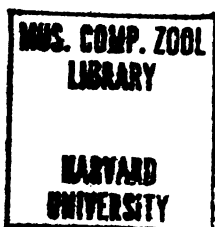


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PREFACE.

THE printing of this book in pamphlet form is the result of a demand from Y. M. C. A. men. It contains the results of studies made for the purpose of preparing certain lectures on this subject for a Y. M. C. A. course. The men wanted the lectures in printed form, and the studies were published in the *Bibliotheca Sacra*. To make them readily available a special edition was then prepared expressly for Y. M. C. A. men. It cost considerably more than was expected; but while it lasts copies will be sent to any part of the world, postage paid, on receipt of twenty-five cents. Send to the address given below and write your name and address plainly. A quarter in a coin card is the simplest and easiest way to remit; but a P. O. order is safer. Do not omit any part of your address: the author is not a medium or a seer.

HERBERT W. MAGOUN.

70 Kirkland St., Cambridge, Mass.

CHAPTER I.

THE PROBLEM.

THE nineteenth century was an era of remarkable progress; but it was also an era of doubt. Developments along many lines contributed to these ends. Near its beginning comparative methods of study were introduced, and scientific research was placed on a solid foundation. Inventions of divers sorts and kinds, all tending to revolutionize established methods of living, appeared one after another in civilized communities; and a spirit of unrest took possession of many people. Questions concerning things supposedly settled began to arise, and among them was that relating to the character and extent of the Biblical flood.

Up to the year 1830, no one, provided he believed in the flood at all, appears to have questioned its universality; and no one who accepted the Bible as the word of God, in any sense, seems to have doubted the authenticity of the account as it stands in Genesis. After the appearance of Lyell's "Principles of Geology," a change began to take place in the attitude of both scholars and laymen toward this particular story, and by degrees it was assumed that the experiences attributed to Noah, though having some sort of a foundation, were in reality much less important than had been supposed, since the Bible account was now regarded as probably nothing more

than an exaggerated description of some local disturbance. This assumption gradually gathered strength, until it came to be generally accepted by "progressive" thinkers.

If any such supposition is true, however, it must be admitted that the narrative displays some remarkable features. Exaggeration, indeed, seems hardly an appropriate term to employ in the premises. It is entirely too mild. To begin with, the ark is represented as landing upon the mountains of Ararat, which are located in Armenia, although Noah is supposed to have done his shipbuilding in the lower Euphrates valley,¹ the belief that he did so being strongly supported by the Babylonian version of the legend. Now, as has already been shown by Dr. Wright, this involves the conclusion that the ark floated up-stream.² Here is a genuine difficulty, but it is only one of several. The Bible story not only involves a journey inland and up-stream but, according to the generally accepted view, it also involves a journey of not far from five hundred miles to the northward and a journey that did not end until the vessel was stranded on the top of Mount Ararat, which is approximately three and a quarter miles above sea-level. This peak is the highest mountain of the region, now rising over

¹ According to Gen. ii. 8-14, a single river (this fact has been ignored) watered the Garden of Eden. It flowed out of Eden (the general region) and was there parted into four heads:—the Pishon (Euphrates), the Gihon (Tigris), the Hiddekel (Dialas, now DIALA), and the Euphrates (Arsanias, Murad Su or Eastern Euphrates). The Hiddekel means the Tigris, so that in each instance the name of the smaller river has driven out that of the one to which it was tributary. Minor streams are ignored. Paradise was thus near ancient Babylonia, as has been suggested; but this simple and apparently self-evident solution of the river difficulty seems never to have been thought of. It fits into all the details, makes it clear why the Tigris and Euphrates are mentioned last, and implies that Noah did live somewhere in that region.

² See *Bibliotheca Sacra*, vol. lxx. p. 283.

seventeen thousand feet above the sea, and it is practically certain that its altitude has been diminished rather than increased since that day.¹ The account distinctly says that the highest mountains were covered, and it has therefore been assumed erroneously that the ark must have landed on Ararat itself.

If a mere local flood furnished the data, it is not enough to conclude that the account is improbable on its face; for no such catastrophe — one able to meet the requirements of the case — could have taken place by any possibility, unless all ordinary flood conditions were surpassed. Indeed, to produce such a deluge, locally, it would be necessary for the entire region, mountains and all, to be suddenly depressed to a depth of about three miles and a half, and then to be elevated again to its present position. For such a change no adequate cause has appeared, and none is likely to appear. Local floods, moreover, are not wont to carry vessels of the size of a modern Atlantic liner — the Biblical ark was approximately 500 by 80 by 50 feet — five hundred miles inland and then deposit them high and dry on a mountain not far from three miles above the level which they occupied when the flood overtook them.

Why the destructive critics have not seized upon this most extraordinary and most improbable feature of the story — they seem to have accepted Ararat as the place — as a reason for discrediting it altogether, it would be hard to conjecture, were it not for the possibility that they have somehow failed to realize what is involved in the conditions. That they are capable of such an oversight is clearly shown by the brilliant superficiality which has characterized the greater part of their work. Not only is this brilliant superficiality a marked feature of such work among modern critics but it has also been a pecul-

¹ See below, second chapter.

ilarity of their predecessors. The fact has not been generally recognized; but it now seems likely that it will be and that too before many years. There are, doubtless, Biblical scholars who will be loth to admit this, but the reality remains and will remain. The truth is that men are seldom originators. They are mostly imitators, with here and there an obstructionist or a doubting Thomas.

Few individuals can do their own tailoring. Most persons of the male sex, in this part of the world at least, buy their clothes "ready made." Those who are more particular have them made to order. A few, mostly professionals, do their own work and make garments for themselves. This is only what ought to be expected. The peculiarity is that a similar statement holds good of thinking. Few men do any real thinking for themselves. The great mass buy their thoughts from day to day prepared in advance to suit them. Some few are particular and hire their thinking done by certain professionals whom they have come to rely upon for such purposes. It is easier to do this than it would be to think the thing through for themselves. Men who make it their business set the style for our outer garments, and, in a similar way, professional thinkers determine our mental fashions by selling us their wares or else by foisting their productions upon us. We are not over particular, in this latter connection, concerning either the fit or the goods, provided the combination bears the trademark, "Made in Germany."

Now, there is an old formula, which has happily become threadbare, although it was once in common use among philologists. It is this: "Every school-boy knows." Classical scholars have come to recognize such expressions as a "bluff" pure and simple, and a like condition is fast obtaining in another field, where a similar history is being enacted; for the

theologians are passing through a corresponding experience. As to the expression, "the trend of scholarly opinion," it is perhaps enough to say that its users all recognize more or less distinctly that they are treading on shifting sand. But there is another formula and a much more seductive one, namely, "the established results of modern scholarship," of which it may be said that a searching analysis frequently fails to find any such results, and it often reveals a woeful lack of thoroughness in their attempted production. The rank and file cannot be expected to know this, although they undoubtedly do feel it, in a more or less nebulous way; but educated men ought to know it, and they should at least look with care at the opposite side of every question before fully accepting any conclusion that either openly defies or flatly contradicts some long-established belief, especially where such belief arose from supposedly reliable data. The belief may be wrong in minor details, and it often is; but this is likely to be the result of a misunderstanding and therefore merely an incidental outcome of a false interpretation rather than the product of an error in the original documents. It is accordingly fallacious to assail the authenticity of the records and then condemn those who still have confidence in them, as "not up to date" or "behind the times." Retrogression is not progress and never will be; but much of what is now "up to date" is really retrogressive and nothing more. Sooner or later the fact must be faced. Happily, the discredited "conservatives" are fast recovering their breath and their power of speech; and it cannot be long before they also will have to be reckoned with.

But — to return to the task in hand — peculiar and apparently unaccountable as this particular detail of the supposed legend seems to be, the very improbability of such a journey is in this instance an evidence of the reliability of the account.

Men are rightly held to be incapable of inventing such a tale unless they embellish it with fantastic and often ridiculous circumstances. And yet no features of that character are to be found in the Bible story. Not only is this true, but the very *crux* of the narrative, the improbable inland journey of half a thousand miles, fits and fits admirably into certain requirements of modern geology. More than a score of difficult geological problems may, in fact can, be solved in a simple and rational manner, provided the Biblical version is a true account of events that actually occurred. Rash as this assertion must appear, it can be justified; and it is the purpose of this series of papers to show in what respect such a statement can be true. A few points need to be noted first, to clear the way for what is to follow.

It is not to be supposed that the voyage inland and upstream is a peculiarity of the Genesis record. On the contrary, it is a common feature of the flood legends of various peoples. The Greek Noah, Deucalion, with his wife Pyrrha, is reported to have been carried away by the engulfing waters and to have landed on Mount Parnassus, or on Mount Othrys in Thessaly. The general direction taken must have been north, and the distance traveled must have been considerable, provided any such journey ever took place. He is said to have constructed the vessel at the warning of his father, Prometheus. According to the *Çatapatha Brāhmaṇa*, the Hindu Noah, Manu, fastened the cable of his vessel to the horn of a great fish, a Jhasa, and was thus towed to safety on the slopes of the Himalayas. Here again the same direction is indicated, and the distance traveled is not small. It must have been sufficient to land him beyond the summit; for it is distinctly said that he passed over the mountains of the north and gradually descended as the waters receded. The Mexican Noah, Tezpi, with his wife Xochiquet-

zatl and their children, landed on Mount Colhuacan. The Babylonian Noah, Xisuthrus, with his family and his most intimate friends, as he is portrayed in the Nineveh flood tablet, was driven by the tempest from Sippara, the City of the Sun, which was situated a short distance north by west from Babylon; and his involuntary voyage was continued for a week, or until he landed on Mount Nizir somewhere in Armenia. His journey is thus made to correspond closely with that of Noah himself; for the mountains of Ararat are in Armenia. According to Berosus, pilgrims went, even in his day, to the Gordyan Mountains in Armenia, in search of wreckage or other remains of the ark to use as amulets against witchcraft.

These and other incidents of the Bible account are preserved in various forms. The Peruvian Noah is made to travel many hundreds of miles to a country he knows not of. Wind, water-spout, and rain assail the Babylonian ark. But it was only for six days and nights: on the seventh day the rain is reported to have ceased. Xisuthrus sends out a dove, a swallow, and a raven, while the Mexican Tezpi sends forth a vulture and a humming-bird. A coin, or medal, said to have been struck at Apamea in Phrygia, near the end of the second century A.D., bears on its face the likeness of a floating ark, which contains a man and a woman, the ark being inscribed with the word NOE in Greek letters, while above it a bird carrying a branch is represented as flying toward them. These things are interesting; but there are others of much greater importance. According to Genesis vii. 11, "the same day were all the fountains of the great deep broken up"; and other accounts contain similar statements. The Babylonian says that waters belched forth from caverns and overwhelmed the earth; but, as Ovid tells the story,¹ Neptune helped Jupiter to produce the flood

¹ Met. i. 274 ff.

and, striking the earth with his trident, made it shake and laid open the sources of its waters. Rivers then burst forth and rushed over the plains, until all became a shoreless ocean. In the dissertation "On the Syrian Goddess" attributed to Lucian (sect. 12), what is said to be an Aramæan tradition relates how vast masses of water suddenly burst forth from the earth with a great rain. Rivers overflowed their banks and the sea passed all bounds, until everything was covered with water. The account then goes on (sect. 13) to tell of a huge chasm which swallowed up the flood. A Druid legend holds that the waters of a lake, *Llyn Llŷon*, burst forth and covered the face of the whole earth. Preceding this catastrophe, it teaches that a pestilential wind arose, and this was followed by a tempest of fire which split the earth asunder to the great deep and allowed *Llyn Llŷon* to burst its bounds. "The waves of the sea lifted themselves on high round the borders of Britain." The rain also came down in torrents. The "Patriarch" and a "select company" escaped in a vessel which had a strong door; but another Celtic legend maintains that only Dwyvach and Dwyan escaped and that too in an open boat.

A new feature is here introduced into the account; namely, an earthquake of stupendous proportions. But the Chinese story duplicates it in the book called "Li-Ki," according to which "the pillars of heaven were broken," the earth shook to its foundations, the sun and stars changed their motions, the earth fell to pieces, and the waters within it burst forth with violence until they overflowed. Even in Greenland a similar legend has been found; for the natives teach that "the earth was once tilted over," and that all men who did not become fire spirits were drowned, as a result, save one. To substantiate the story, they report that various remains of fishes have been found far inland and that the bones of whales have been

discovered on high mountains. They seem to believe that these facts prove the legend to be true. Many more details might be given; but it is hardly necessary for the purpose in hand, and this side of the question has already been ably treated by Mr. William Restelle.¹

It may be fair to ask where all these notions came from. Are they merely variations of a single original, and, if so, what mean their divergences? Are they nothing but the wild dreams of excited or disordered imaginations? Were the whale skeletons placed upon the mountains by the natives themselves, and, if not, are they without significance? Or did the Greenlanders invent the story? Would they be likely to do so, or can it be corroborated by any similar facts? Apparently it can. Oyster shells and the shields of crabs are reported on good authority to be found in the sands of East Tartary, far from the sea-coast; and the Mongols are said to assert that the whole region was flooded at one time and that from time immemorial it has been told how in remote antiquity a deluge covered the district and left land in its place when it finally retired. Is this pure fiction, or without bearing on the case? Where so much smoke is there must be some fire. What is it?

The problems concerning bones and shells are properly geological ones, and they may therefore be grouped with the others already referred to, which are more or less familiar but need to be briefly enumerated at this point. Where did the loess originate? It is scattered far and wide and is found in some places to the depth of hundreds of feet. Is it volcanic mud? And does this solution, if it is a correct one, fully explain how such a peculiar loam came to be distributed over Belgium and Germany, England and France, China and Russia, Canada and the United States, to say nothing of the South-

¹ See *Bibliotheca Sacra*, vol. lxiv. pp. 148 ff.

ern Hemisphere? It strongly resembles a certain glacial product. Is this a mere accident? It found its way to the top of the islands of Guernsey and Jersey, although they are many feet above sea-level and it is difficult to see how they could have obtained such a coating identical in character, as it is, with that found on the mainland. How did it do so? And then, too, there is the rubble drift, which is another characteristic of these islands. Where did this come from? Its sharp and broken pebbles, evidently from local sources, indicate some sudden and violent disturbance like that produced by rushing water; but no regular action of such a sort can have been possible, since the pebbles themselves are not water-worn or otherwise abraded, and they rest at a point some distance above the level of the sea. And how about the raised beaches and dunes of blown sand which underlie them? How did it happen that these were not disturbed to any great extent?¹

Next come the peculiar deposits known as Breccia. These are composed of fragments from adjacent rocks and are intermingled with broken bones. It is a strange combination and it fills to the brim many remarkable fissures in the hills and limestone cliffs of Southern Europe. What made these fissures and their unusual deposits? The bones are those of carnivora and herbivora mixed together in endless confusion; but there is not a particle of evidence that any of the living animals were ever the prey of the others. At Santenay in Central France, two such clefts have been found, and fissures of a like character exist on the rock of Gibraltar. Near Palermo, in Sicily, similar deposits have been discovered, which contained a vast quantity of dismembered Hippopotamus skeletons strangely commingled with occasional bones of the ox, the deer, and the elephant. How was it done? In the limestone regions of

¹ See *Bibliotheca Sacra*, vol. III. pp. 724 ff.

Southern England, such fissures abound, and the bones are those of the ox, horse, deer, wolf, hyena, tiger, hare, water-rat, weasel, boar, etc. But that is not all; for Malta exhibits deposits of the same general character, and they are also abundant in certain other islands which lie along the Croatian coast near the northern end of the Adriatic Sea. How are they to be explained? Similar conditions exist at other points on the Adriatic and indeed all about the Mediterranean, and it is also said that many parts of Southern Europe and especially the railway cuts in Swabia have revealed extensive remains of the mammoth, which could never have been so well preserved unless the animals were suddenly buried in large numbers. How was it done?¹

Vast areas of Northern and Central Europe are covered by beds of gravel, sand, and clay; and they have the same characteristics as similar beds which are known to have originated from the action of water. They contain stones and even boulders, occasional human remains and implements, and, in some instances, great quantities of broken and disjointed skeletons identical in character and in lack of coördination with those of the neighboring breccia. How were these beds produced? And why are they filled with such a conglomeration of bones? Did the latter bury themselves? Human implements and, here and there, human remains are found in the loess; but there is no evidence of design in their location. What does that mean? Boulders likewise occur in the loess. How did they get there? Bones there are in the rubble drift, but no remains of marine animals. What does this signify? Piles of clean and unbroken shells of different kinds and different habitat are said to be found in countless numbers, in a heterogeneous mass, at

¹ See *Bibliotheca Sacra*, vols. lli. pp. 729 ff.; lix. pp. 699 ff.; lxiv. pp. 537 ff.; and Urquhart's *New Biblical Gulde*, vol. i. pp. 361 ff.

Uddevalla in Sweden, on the Skagerak; and they are reported to show every appearance of having been deposited by some sudden inundation, since life in such a position was an impossibility. Is their appearance deceptive? And, if it is, what was the true cause of such a curious phenomenon? The other deposits already mentioned are repeatedly found far above the level of the ocean,—in some instances their elevation is fully twenty-five hundred feet,—and they extend over vast regions in an unbroken expanse. How is this to be accounted for?

In some places, near high hills, bird remains, along with those of animals, have been discovered, while in others, in Siberia, mammoths with their buried and frozen bodies all pointing in the same general northerly direction, as if they had been overwhelmed and ingulfed in the midst of a fearful headlong flight to higher ground, have been unearthed. What do such things seem to imply? And how did it happen, in those same regions, that rocks, twigs, and the leaves of trees were covered with deposits of sand, loam, and magnetic sand, which, to the depth of even one hundred feet, show distinct evidences of having been deposited at one and the selfsame time? Great masses of gravel are spread over a large part of Northern Africa, and a similar condition prevails in Patagonia. What can be postulated of their origin? And what is their meaning?

Now, the animal remains that are found in these many deposits, including the breccia, although they differ in different countries, are always of the same species and genera, and they all belong to the same geologic age. They are to be classed in every instance as Palæolithic, and they disappeared at the end of that period. Huge and powerful and numerous beyond computation, they nevertheless suddenly ceased to be. They seem to have been thoroughly and completely destroyed. How was it done? The same peculiar condition is found to

exist in Europe, in Northern Asia, and in North and South America. Climatic changes did not do it, nor yet did man; for he disappeared in like manner. No remains of Palæolithic men are found with those of the Neolithic race, and, what is more, a great gap separates these two forms of human life from one another. What caused that gap? There must have been a reason for it. Had Noah's flood anything to do with it?

That the phenomena already mentioned point clearly to some frightful catastrophe, which involved the action of a single great deluge or of different local floods extending over districts of a greater or less extent, has long been held; and to this opinion weight has been given by such men as Cuvier, Buckland, Hugh Miller, Sedgwick, Dana, Murchison, J. W. Dawson, Howorth, Erman, Geikie, the Duke of Argyll, Claypole, Prestwich, and Sir Henry De la Beche. Were these men mistaken? A sudden submergence will seemingly account for practically all of the results. Is it an impossibility? The facts appear to support it and to be final, as Rev. D. G. Whitley has clearly shown.¹

But there are yet other riddles involved. How, for instance, did arctic seals find their way to Lake Baikal and to the Caspian Sea? They are there, and their characteristics have not been materially altered since they took up their abode in such unexpected quarters. Though land-locked and living in water that is fresh or comparatively fresh, they still persist in maintaining their ancient traits even in the Caspian. How is this to be explained? And why has the Caspian only about a third as much salt in solution as the ocean? The Aral Sea is even more remarkable; for it is still sufficiently fresh for animals to drink. Lake Baikal has an outlet; but the other two bodies of water are land-locked. Why are they not more salt?

¹ See *Bibliotheca Sacra*, vol. lxi. pp. 519 ff.

Other such seas are decided saline. What has made the difference?

At Kief, on the Dnieper, Professor Armachevsky found human implements and burnt stones, together with bones of extinct animals, at a distance of fifty-three feet beneath the undisturbed loess. How came they there? A glacial deposit was beneath them. What is the significance of that fact? Similar discoveries have been made elsewhere. What do they mean? The Chinese have a tradition that the vast tract now known as Gobi, which simply means the "Desert," was once an immense expanse of water called Han-Hai; and the tradition has every appearance of tallying with the facts. Lob-Nor, in Chinese Turkestan, which is hardly more than a marsh at the present time, is a relic of that inland sea. What does the former existence of such a body of water signify? That these facts are all to be connected with those already given, Dr. Wright has made evident, and he has done so convincingly.¹

But the end is not yet. The channel of the Hudson River is said to extend out into the ocean for approximately a hundred miles beyond Sandy Hook and to occupy a sort of cañon averaging a thousand feet in depth. Other rivers, such as the Delaware and the St. Lawrence, show similar depressions beyond their mouths, and like conditions obtain on the Pacific coast of North America and on the Atlantic coast of Europe. What is the lesson which they teach? Has it any connection with the fact that borings for oil in various parts of the United States have brought to light eroded channels in the rocks, where now a mass of glacial *débris* fills the entire cutting? And if these old channels were thus filled up during some former age, why did such a basin as that occupied by Lake Baikal fail to suffer the same peculiar fate? In a

¹ See *Bibliotheca Sacra*, vol. lxx. pp. 707 ff.

northern latitude characterized by intense cold, Lake Baikal has a lofty mountain environment and but a single outlet. Might it not be expected that its bed would show some traces of a similar glacial deposit? And yet this lake does not appear to have been perceptibly affected. It still has an average depth of half a mile, and it is nearly a mile in depth where the silt from the inflowing waters should be the deepest. How did it chance to escape? And why has the enormous mass of sediment that is known to be constantly emptying into its basin made no more of an impression than it has? The Dead Sea, in like manner, is receiving from day to day all the mud that the Jordan brings down from the regions above it; yet its depth has been but little affected. The results produced by sedimentation are conspicuous enough elsewhere, as in the deltas of the Nile and the Mississippi; but they can hardly be detected here. Why not? Between this sea and Lake Baikal there lies a region that was once well watered, although it is now sufficiently barren. Traces of ancient lakes are to be found in many places, and most of the locations contain salt beds at their bottom. The country is one vast basin with no outlet to the sea and no connection with it. Where did these lakes come from, and where did they obtain their salt? These questions are all pertinent to the general problem.¹

There remains a group of phenomena which form a class by themselves. On Kelley's Island, in Lake Erie, grooves have been found in the rocks, which resemble nothing so much as the work of some giant moulding plane. In divers other places similar grooves are known to exist, although they are not so remarkable as these; and, in many instances, scratches too rough or too insignificant to be classed as grooves have been discovered on the surface of the ledges which underlie the soil.

¹ See *Bibliotheca Sacra*, vol. 11x. pp. 537 ff.

What caused these markings? In some places, large masses of till, or unstratified boulder clay, now lie above great quantities of stratified stones; and boulders are occasionally found in the clay. What does this mean? Boulders occur at a distance of even eight hundred miles from their place of origin, as is made evident by their composition; and some of them are located at an elevation as great as three thousand feet above their former resting places. They are often of huge size. How did they get there? And what of the Drumlins, or hills of till? Lenticular in shape, they form a conspicuous part of the landscape and often add to its beauty. Such are common about Boston. What formed them? And what formed the Kames, or hills of sand and gravel that resemble a rolling prairie? Something must have done it. Finally, what of the Moraines? These strange accumulations of rocks, intermingled in vast quantities and in a curiously irregular manner with earthy *débris*, have been traced across the United States from Northern Pennsylvania to Southern Illinois and thence to the northwest into Canada. In the western mountains they trend to the south again; but they are all confined to a limited area and show a certain regularity of location in the two or more nearly parallel lines formed by them. Nothing else like them is found in the neighborhood. In Europe a similar line runs from the southern limits of Great Britain eastward through Germany and Russia, then northeastward and ultimately northwestward through Eastern Russia to the sea. Drumlins and kames are also met with. In the plateaus of Asia similar conditions are known to exist. How are these facts to be interpreted?

With a single exception, this concludes the list. It is a formidable array of scientific enigmas, roughly outlined with little or no regard for minute details. They are certainly puzzling; and yet it is not impossible to find a satisfactory solution for

every question that has been mentioned. Data from existing conditions furnish the key to a large part of the problems, and it is not too much to say that the scientific imagination can be trusted to postulate the rest, provided there is a strict adherence to known facts and nothing is assumed that runs counter to the laws of nature or to human experience as far as it goes. To begin with, the phenomena attending modern accumulations of ice show conclusively that the peculiar conditions dealt with in the last paragraph are precisely like the ordinary products of glaciation at the present time, although they are of such a character that they must have been the outcome of glaciation on a gigantic scale. In size and extent they differ from the results observed in connection with modern glaciers but not otherwise. These last riddles may accordingly be regarded as having been successfully solved. They have been carefully dealt with by Dr. Wright in his "Man and the Glacial Period," and in a still more masterly fashion in his "Ice Age in North America." With regard to these, then, there need be no further concern. The phenomena involved are due to ice or to its melting, but to ice in enormous masses and of vast extent.

At this point a new difficulty arises concerning the origin of such immense accumulations of ice. The cause is not certainly known, and conjecture must be resorted to, as it has to be in all matters not capable of a mathematical demonstration or of positive proof. Conjecture holds an important place even in the most sedate of sciences, as is attested by the Nebular Hypothesis. It is the very foundation of Evolution, some of whose teachings seem destined to survive while others slowly perish. Recent tests, made with the blood, appear to prove not only that all men are but variations of a single species, but also that no Anthropoid ape could possibly have been the ancestor of man, a conclusion already reached on other grounds by various

investigators. The wave theory of light required the postulation of ether, a substance which no one has yet been able to isolate, and a return to the corpuscular theory now seems imminent. A working hypothesis is usually all that can be expected in such cases because of a lack of sufficient data. Such an hypothesis will be offered in the next chapter. It will seek to account for the ice accumulations and to show, in a general way, whither the diverse and widely scattered threads of this whole great problem appear to lead. In the present chapter, it only remains to refer to the exception noted above, which has to do with certain conditions found in the ocean bed or floor. No one seems to have thought of connecting them in any way with the phenomena already mentioned, and it accordingly appears desirable to treat this particular phase of the subject by itself. Exploration has now made the conformation of the ocean bed, in its main features at least, a matter of practical certainty, and the peculiarities of its topography are such that they seem to bear directly on the subject in hand. It is too early to say just how much importance may be attached to the points at issue; but they appear to be connected in a vital way with the ultimate effects of glaciation. How this can be true may not be altogether clear at the start; but in the following chapter it will become more and more evident as the argument progresses. What, then, are these seemingly remote elements in the problem?

As is well known, the ocean floor is quite irregular. Much of this irregularity is doubtless due to the effects of shrinkage; but certain considerations lead to the conclusion that there was something more than shrinkage involved in the conditions found to exist in various places. A great plateau or ridge, varying in shape and dimensions, is encountered in almost every part of the mid-Atlantic. On either side an extensive

depression appears, showing a depth of from sixteen to twenty thousand feet, with an occasional basin two or three thousand feet deeper yet. Above the plateau the depth averages twelve or thirteen thousand feet; but there are places only six thousand five hundred feet in depth. Shrinkage was doubtless the original cause of this peculiar arrangement; but the plateau shows evidence of a later modification due to other forces. What caused that modification?

With the exception of the Bermudas, the Atlantic is practically free from coral islands. These number about three hundred in all, and they occupy a shoal or platform approximately twenty-three by thirteen miles in extent. Outside their immediate neighborhood, the water reaches a depth of about fifteen thousand feet. To account for the facts, it has been supposed that coral started to grow on the top of a submarine mountain, which then settled gradually until a great depth was reached. Subsequent changes turned the coral into limestone; but that was not all. Coral does not grow above tide water; and yet these islands reach a maximum elevation of one hundred and eighty feet. How did they obtain it? Admittedly, by an elevation probably connected with a much larger elevation of a comparatively recent date. This will now be considered.

The Madeiras, Canaries, Cape Verde Islands, and St. Helena, lie in the East Atlantic. The Greater and Less Antilles are in the West Atlantic. In the Central Atlantic are the Azores, Ascension Island, and Tristan da Cunha, a group of three small islands, one of which is more than a mile in height. They are volcanic in origin, as are all the others named; and it does not appear that any of the islands in the list antedated, in their present formation, the later Tertiary or Upper Miocene period. Since that time, however, as shown by their fossil de-

posits, many of them have suffered an elevation, said to amount, in some instances, to fifteen hundred or even two thousand feet. What caused it?

Certain details may not be amiss. Ascension Island is a solitary peak on a submarine ridge between the North and South Atlantic basins. It is covered with the usual products of volcanic action and abounds in the steep and rugged ravines which are wont to be left by such disturbances. On the north, the Azores rise from the great mid-Atlantic plateau, which seems to extend continuously from that point northward to the latitude of Newfoundland and southwestward to the latitude of Florida. They contain many hot springs and boiling fountains. Sulphur deposits surround the latter, and vapors issue from many crevices. Extinct volcanoes, deep ravines, earthquakes, subterranean eruptions, and "Muddy Crater," with its boiling caldron, all testify to the volcanic origin of the group. On the south, Tristan da Cunha rises from a low submarine elevation, which runs down the Central South Atlantic. These islands are also plainly volcanic, the largest being a great cone or crater flanked by precipitous cliffs. One of them shows evidence of a later elevation. The Madeiras, off the coast of Morocco, are the summits of lofty mountain peaks, whose original rocks were covered by the ejectamenta of volcanoes during the Miocene or later periods. There is abundant evidence of a later upheaval in mass; for marine shells of the Miocene period are found in different places at least twelve hundred feet above the sea. Leaf beds occur beneath twelve hundred feet of lava, and some of the leaves have been identified as those of living species. The ancient stones beneath the volcanic deposits show great alterations and dislocations. Craters are rare, and no signs of life appear in them, although lava once flowed and solidified about conical hills which are

plainly of a late formation. On some of these hills cinders and slag, seemingly of only yesterday, are found. Deep ravines, as well as the great confusion now existing in the stratified rocks, testify to the violence of former earthquakes, and the inference is clear that a great cataclasm overtook the group at no very remote date.

Near by are the Canaries, which are likewise mountain summits of a similar character. Within one hundred and twenty years lava streams have issued from the mountain sides, and red bands of laterite between some of the deposits of lava indicate long periods between eruptions. Certain shells in raised beaches give evidence of upheavals during the Pleistocene period, which includes the Glacial Epoch. Further down the African coast are the Cape Verde Islands, also plainly volcanic. Marine shells imbedded in tufa bear witness to an upheaval of some recent date. Still further south is St. Helena with its huge and broken crater. It contains other evidences of volcanic action.

The Antilles are left. They rise from a more or less distinct plateau lying between North and South America. Fossil remains of South American animals which perished with Palæolithic man, found in the islands and on the adjacent northern coast, show that they once formed a connecting link between the two continents. Pleistocene times are given as the date of this condition of things. Hayti shows special evidences of metamorphic changes; but many of the other islands are also plainly volcanic, at least in part. Coral reefs along the shores, limestone below the two-hundred-and-thirty-foot level, and the coral-formed Bahamas just to the north, all point, however, to a period which may have antedated volcanic action. It should be added that calcareous sand is found in the Cape Verde Islands, while limestone appears in the Madeiras, St.

Helena, and Jamaica, in the latter instance overlying igneous rocks.

The above facts plainly imply that coral growths in the Atlantic were, in some instances, overwhelmed by volcanic agencies. They also go to show that at some time during the Upper Miocene period great pressure in the earth's interior began to produce volcanic disturbances in the Atlantic region, and that these continued, apparently with increasing violence, well into the Pleistocene period. They seem to indicate that the ultimate outcome was a great uplift, of which evidences still remain, and that this uplift affected extensive portions of the mid-Atlantic plateau. What caused it? It seems to tally with the close of the Glacial Epoch so far as its date is concerned. What is the meaning of the coincidence? Is there any possible connection between the two?

Of the Pacific less is known; but enough is established to be significant in the premises. A stretch of shallow water in the Central Pacific shows a submarine plateau trending northwesterly and southeasterly on the eastern end of which the Sandwich Islands are located. They are volcanic; but they show signs of other earlier formations, coral and lava being found interstratified, and they contain indubitable evidence of a great elevation during some former age, since there are old coral reefs a hundred feet above the water, beds of coral limestone four hundred feet above the sea, and coral sands four thousand feet above sea-level. The entire area occupied by the islands is involved. A similar plateau supports the Ladrões and the Carolines, which also show both coral and volcanic elements. To the eastward two plateaus support the Marshall and Gilbert Islands, which are largely atolls. Many other oceanic islands, most of which occupy similar plateaus, are found in the South Pacific. A few are mountain peaks.

Most of the Pacific is from twelve to eighteen thousand feet in depth. The eastern half is especially uniform and free from islands; but the western is quite the contrary. Just east of Japan and the Kuriles depths greater than twenty-seven thousand six hundred feet are reached, and a basin averaging twenty-four thousand feet stretches eastward in the "Tuscarora Deep." Northwest of the Carolines is a similar though small depression, while shallow seas faced by submarine plateaus line the coast. These plateaus are studded with islands, whose plant and animal life furnishes evidence that Asia once included Japan, Formosa, the Philippines, New Guinea, Australia, and probably New Zealand. The oceanic plateaus seem to indicate an area of elevation which continued this great continental shelf southeastward, while stretching out to meet it is another, on the western coast of Patagonia, which is variously represented. Some make it cover more than 40° of longitude, while others hold that it is a part of the great general elevation containing the ocean archipelagoes.¹

According to Darwin, atolls result from subsidencé. The "Challenger" expedition, however, apparently disproved this theory. No evidence of a general subsidence could be found, although evidence of a greater or less upheaval was abundant. Submarine volcanic peaks were discovered, on which deep-sea organisms producing lime and silica were common. This fact needs to be remembered in connection with the Bermudas mentioned above, since it discredits the theory of subsidence there as well as in the Pacific, where submerged limestone is not always to be attributed to the coral polyp. The truth seems to be that deep-sea organisms build on volcanic peaks, until the range of the coral polyp is reached. He then begins his work,

¹ See Enc. Britt. (Ninth Ed.), vol. xviii. p. 115, Plate III., and Cent. Dict. vol. x. Map No. 2.

flourishing seaward but dying toward the center for lack of proper food. The lagoons of the atolls result, because seawater disintegrates dead coral. The absence of the older sedimentary rocks from all these oceanic islands is significant. They are of a late formation.

A fringe of volcanoes, running northward from Cape Horn to Alaska and southward from the Aleutian Islands through Japan to New Zealand, accounts, in part, for the volcanic mud and sand found near the shores of the Pacific; but it does not account for the vast deposits of clay on the ocean floor. "Everything seems to show that the formation of the clay is due to the decomposition of fragmentary volcanic products, whose presence can be detected over the whole floor of the ocean." These are supposed to come from floating pumice, volcanic ashes, etc., from the lands near by; but "it is also known that beds of lava and of tufa are laid down upon the bottom of the sea," and that these decompose in sea water.¹ Pumice is found everywhere, and its presence on the ocean floor is admittedly remarkable. What do these things mean?

The borders of the Pacific constitute an earthquake belt; Japan testifies to the violence of former disturbances; Java and Sumatra contain active volcanoes, although those of Borneo are extinct; Formosa is partly volcanic, but has, like all the other continental islands, a geological connection with the mainland; Australia contains evidences of a vast fissure in the earth, where the sedimentary rocks have been broken through and contorted by the igneous overflow of basalt and trap, a condition which may explain the presence of igneous rocks beneath the limestone in Jamaica; late volcanic rocks abound in New Zealand; with regard to the Philippines, "it seems certain . . . that much of the archipelago has been heaved from

¹ See *Enc. Brit.*, l. c., p. 125.

below the sea-level within comparatively recent times," while "volcanic forces . . . have had a great share in shaping the archipelago";¹ the Galapagos Islands, west of Ecuador, are volcanic; and the west coast of Patagonia appears to have been shattered by some fearful volcanic uplift, seemingly post-Tertiary, which raised the shingle-covered eastern plains to their present level and left behind it, on the west, more than a thousand islands, as well as the great submarine plateau already mentioned. Conditions in the Pacific, then, seem not only to conform to but also to verify the conclusions reached concerning geological disturbances in the Atlantic; and it may not be without significance that the more important elevated oceanic areas of the Southern Hemisphere are approximately antipodal to what were the northern ice fields during the Glacial Epoch.

Of the Arctic floor little is known; but the ocean itself appears to be comparatively shallow. The Indian Ocean seems to average not far from fifteen thousand feet in depth; but it shows extensive elevated areas over approximately two-thirds of its bed. They follow the coasts of Asia and Africa; for the deepest portions of the ocean are, for the most part, just west of Australia. Ceylon shows unmistakable signs of successive elevations; Madagascar gives evidence of widespread and powerful subterranean action, and it appears to have suffered an extensive late elevation, seemingly post-Tertiary; the Comoro Islands near its northern extremity are volcanic; the Maldives are coral islands on submarine table mountains, probably volcanic in origin; the Laccadives appear to be similar; and the Seychelles are granitic, indicating a probable upheaval from below. The Indian Ocean therefore tallies with the others. It diminishes to less than ten thousand feet in depth as it merges

¹ See *Enc. Brit.*, *l. c.*, pp. 748 f.

into the Antarctic, which shows a still greater elevated area, approximately antipodal to British America. Volcanic islands are known to exist within the Antarctic circle, and the conclusion seems inevitable that vast portions of the ocean floor have been elevated since the beginning of the Quaternary Age and subsequent to the creation of man. Such disturbances do not occur without a cause, and it is legitimate to search for it. An attempt to find a propelling force which would be adequate for the production of these gigantic ocean disturbances will be made in the next chapter; and in the same connection attention will be called, incidentally, to the fact that such a propelling force may possibly account for certain other disturbances, which are known to have taken place in comparatively recent times on the continent of Asia.

CHAPTER II.

THE SOLUTION.

IN ancient times the desire to explain things led to the formation of myths. The same desire now leads to the construction of hypotheses. These are "scientific," if they satisfy all the conditions, are rational, and meet with a general acceptance. As such hypotheses necessarily underlie science, it may almost be said that Science is a lineal descendant of Myth. The word "science" is to some extent a misleading term. As it comes from a root meaning 'to know,' it is popularly supposed to deal only with positive knowledge. Superficially, it does; but its foundations are fairly honeycombed with hypotheses, of which little is heard.

Nature's methods of work, commonly called laws, are familiar enough; but the ultimate constitution of things and their true exciting causes elude analysis. No man really understands what mind is or what matter is or what the actual operation of gravity is or what that of sight is or even what that of digestion is, although some claim to know all about it. There is always something left which man cannot fathom, though he is constantly trying to do so. In recent years, the "indivisible" atoms of antiquity have been subdivided into ions, or 'goings,' and matter seems to be reduced by such a theory to a form of motion. Concerning some things men can only speculate.

So long as this is true, no apology is needed for attempting to provide a working hypothesis which shall account for and harmonize with the scientific data referred to in the previous discussion. Such an hypothesis is plainly needed, and it ought not to be unduly difficult to construct, if every fact is given its due weight. The first thing to be considered is the marvelous accumulations of ice during the Glacial Epoch, for which an adequate cause must be sought. A partial cause may be found in the elevation of the land; for geological investigations show that the greater part of Europe as well as the northern portion of North America was once much higher than it is now, the elevation in places being possibly three thousand feet greater than that of the present day. Such a change of altitude could not fail to affect climatic conditions as they now exist; but *now* is not synonymous with *then*. A tropical climate once prevailed in what are now the Arctic regions. Of this there is abundant proof. What caused it?

The only tenable solution thus far offered appears to be that suggested by Dr. Percival Lowell, who holds that this peculiarity was due to the internal heat of the earth itself. Such a conclusion is not only reasonable but it is also an inevitable outcome of both the nebular hypothesis and the teachings of modern geology. Internal heat was doubtless the primary cause; for it must have kept the ocean at a fairly high temperature, which would favor the production of warm air currents and clouds of steamy mist. The earth, too, must have retained in its crust a considerable amount of heat; and these two things would be enough to account for the facts, since the direct rays of the sun were not really needed. So far as can now be determined, a warm moist climate — no great amount of light was necessary — was all that was required for most of the vegetation then existing, and, as

Dr. Lowell says, the sun could not possibly have dominated the earth's climate, until such time as the vast mantle of clouds, in which it must once have been wrapped, had become sufficiently dispersed to allow the sunlight to reach a large portion of its surface during the greater part of the day.¹

In other words, the sun was not a controlling factor in the world's affairs, until the earth had become cooled to such an extent that the ocean had acquired a fairly low temperature. This would so reduce evaporation that the sun could, at last, have a fair chance to exert its influence. It may be remarked in passing that this fact has a bearing on the "fourth day" in Genesis; but of that at another time.

The reduction in temperature would have another effect; for it would allow snow to begin to accumulate on the highest mountains, in some cases soon after their formation; and such a condition would slowly but surely tend to perpetuate itself, until there was a permanent snow cap in favorable localities at high altitudes, with a corresponding modification of neighboring plant life, etc. Because of certain peculiar complications, however, this result, as will appear below, may have occurred in the Antarctic regions considerably earlier than the time referred to. Elsewhere, apparently, it was as stated. There, for reasons given later, the influence of the sun on the enveloping clouds seems to have been effective at a very early day, as it may possibly have been in a few other limited areas. In time, "partly cloudy" became the normal condition of

¹ See Lowell, *Mars as the Abode of Life*, pp. 46 ff., 70 ff. It is not easy to accept all of Dr. Lowell's conclusions, and it is not necessary to do so; but his ideas are not to be lightly dismissed, and his general position is by no means invalidated by isolated geological facts that run counter to it or appear to do so. See *Science*, April 23, 1909, pp. 659 ff. "Exceptions prove the rule," and they have been allowed for in the present discussion.

certain regions, including probably the torrid zones, which were then in the making. Tropical rains must have been common, and they were doubtless often flood-like in their intensity.

These can hardly have been confined to what are now the tropics, however; for they must have been characteristic of the entire globe for many ages. It is safe to infer that, long before the final dispersion of the cloud envelope, snow rather than rain was the ordinary result of precipitation on lands in extreme latitudes and at all extreme altitudes. But if this is once admitted,—it is difficult to see how it can be questioned,—a rational explanation has been found for the Glacial Epoch, because the precipitation must have continued to be enormous until post-Tertiary times, and extensive snow areas could hardly fail to be produced under such conditions with the lapse of succeeding centuries. The polar seas would continue to be comparatively warm, so that evaporation from that source would still be considerable. The land breezes of those regions would thus be surcharged with moisture; while in regions near the equator, as the heated portions of the atmosphere rose upward, the higher strata—flowing outward to allow the lower strata to flow inward—would carry with them the humidity of the clouds, until the cooler upper air finally sent the dampness back to earth. The precipitation would begin as rain; but ultimately, in the colder zones, it would turn to snow.

Where there was an environment of a suitable character, an ice cap would result. A continent that was low-lying or unstable, or both, would not furnish such an environment even in a high latitude; for inundations or warm air currents, or both, would prevent permanent accumulations of snow, save in isolated mountain regions, whose glaciation would not con-

stitute an ice cap in the technical sense. On the other hand, a fairly high and stable continent in a high latitude would naturally develop extensive snow fields as a result of excessive precipitation, since such a condition implies the presence of a more or less extensive and persistent cloud envelope, which would protect the snow, even though the sun did have some effect in tempering the climate during a part of the year.¹

That such a cloud envelope existed well into the Quaternary Age is practically certain, and elevation and stability were given to the continents during the preceding (or Tertiary) Age. The sunlit belt was gradually expanding; but the snow areas on the high and stable continents were growing in size and depth. By the time the two came together the snow must have been exceedingly deep. Cloud and sunlight had long been struggling for the mastery over a broad expanse, and a prolonged contest was now begun between the sun and the snow, compacted into ice by the enormous pressure. Alternately advancing and retreating glacier boundaries would almost certainly result, and there are abundant evidences that they did. The elevation, however, would enable the snow to go on accumulating where it was still protected by the clouds.

Elsewhere, at the start, the sun would have some advantage, and it may be inferred that the glaciation was considerably diminished in the course of a few centuries. Only the borders were affected in this process; for the ice pack must have gone on increasing in both height and weight near its main centers. In time, this would turn the scale in its favor; but it is hardly to be supposed that the glaciation ever reached its ancient limits, save in isolated instances, since the reduction in cloud areas probably continued, and this must have influenced the final outcome. Ocean currents doubtless played their part;

¹ For the effect of Perihellon and Aphellon, see below.

for they always affect climatic conditions, and the ocean must even then have been many degrees warmer on the average than it is at the present time.

This last consideration may have some bearing on the fact that the ice accumulations appear to have been more slow to develop on our Pacific coast than they were to the eastward, since it may account for a warmer climate in that region. As to the hypothesis that there were two or more distinct periods of glaciation, except in limited localities,—it may be enough to say that with certain exceptions (see below) all the facts can be accounted for on the basis already laid down, and the law of parsimony forbids the postulation of more than one glacial period, unless such a postulation becomes a necessity to account for conditions otherwise inexplicable. An effective cause for a second ice cap and an adequate explanation of the destruction of the preceding one are elements in the problem, and for the Northern Hemisphere these things constitute no small barrier to the acceptance of separate ice ages in any true sense. Changes there doubtless were in the glaciated areas. In places also the land may have been somewhat unstable, and local conditions may have varied; but an ice age is not ended by local variations, and slight alterations of altitude, such as have been suggested by geologists, are not enough to cover the requirements in the premises. Neither are the changes that have taken place in the relation of Perihelion and Aphelion a satisfactory explanation of all the phenomena, although these had an important part to play as factors in the outcome. Actual submergence, such as the evidence seems to call for at the close of the Ice Age, involves too many consequences to be lightly appealed to, as will presently be made clear.

No one supposes that a vast empty space ever existed in the interior of the globe; and yet, if it did not, it follows that if the continents were once higher than they are now something else must have been lower to provide a compensation. The earth's shrinkage would make some difference; but it would hardly account for so great a discrepancy as must be accounted for, and shrinkage has usually meant wrinkling downwards as well as wrinkling upwards. This should be self-evident. It has far-reaching consequences. Whenever a portion of the earth's surface has suffered submergence, unless the movement has been a slight or a very limited one, it is safe to infer that some other part of its crust has been thrust upward. "Two bodies cannot occupy the same space at the same time." This is a law of Physics, and it is not abrogated in the earth's interior. Caverns there may be; but they are not large enough to balance a continent.

It should accordingly be clear that if Europe and North America were once higher than they are now, as was indicated in outlining the problem, some other part of the world must have been lower than it is at the present time. Conditions on the coast line of both continents favor the conclusion that the ocean really was lower at one time than it is in our day. Its bed may therefore have been deeper, on the whole, than it is at present, when this was the case. A comparatively plastic condition of the crust would make such a deepening possible, and Astronomy has recently furnished an exciting cause for such a deepening by showing that the moon was once a part of the earth itself but became separated from it at some time in their history.¹

¹ See Lowell, *Mars as the Abode of Life*, pp. 16 ff. There is still considerable uncertainty concerning the movements of the earth's crust and their causes. The ocean beds were apparently outlined at

Now the Pleistocene ice pack must have steadily encroached upon the ocean by depleting its waters, and the great

the beginning; but they have been deepened at some time in the remote past. (See Enc. Brit. (Ninth Ed.), vol. iii. p. 16. Such a movement, accompanied by a corresponding upward thrust, or rather pull, may have taken place at the time suggested. Just when that was, is uncertain; but the extensive disturbances, including mountain-making, the ejection of igneous rocks, and the extermination of animal life, which took place at the merging of the Carboniferous and Mesozoic ages, may possibly be attributed to this cause. Some have assumed that the moon once reposed in the bed of the Pacific; but it seems more likely that the Antarctic continent or archipelago—it is uncertain which is the better term—represents the stub from which the moon broke away. Molten matter must have been drawn outward in the process (the meteorites are witnesses of this), and the ocean bed must have settled somewhat to atone for the loss. (See below.) The place of separation would ultimately be high land, ragged and volcanic, and much of the moon's surface would resemble it. The facts seem to tally with these considerations in each instance. But if the earth and moon were once a pear-shaped body (see Lowell, *l.c.*, and G. H. Darwin, *The Tides*, pp. 276 ff., 342), they must have revolved about a common center of gravity—they do so yet—as well as about a common axis; for otherwise they would have merged into a single globe. (The first motion is supposed to have occupied five hours or less, the time of the second is not certain, and the time of both has apparently been changed by tidal friction. See Darwin, *l.c.*, pp. 264 ff.) Earthy and especially aqueous matter would thus be drawn toward our Northern Hemisphere and drawn with increasing force as the speed diminished (cf. *Ibid.*, pp. 316 ff.),—a consideration which may help to account for the present excess of land in that region as well as for its early submergence and general instability. The cloud cap at the small end of the pear would soon be dispersed; for the cooling would be rapid, since this end must have had less than one-eightieth of the total mass, as the moon now testifies. With the heat, the vapor would speedily vanish. In time the sea also would tend to depart almost entirely from this portion of the joint body as the waist contracted with the loss of speed (see below); for the attraction of the larger end and its tendency to bulge northward would be too powerful to resist. Dry land would thus become the portion of what was to be the moon, and this would be likely to unite with South America, Africa, New Zealand, Australia, and even India, *via* the East Indies and Siam. The peculiar fossils of those regions may find an explanation in this possibility, although glacial conditions, due to the

plateaus beneath the surface of the sea along the coasts of the ancient Atlantic must have been more and more exposed, until they became dry land. Elevation also did its part. These

moisture-laden winds, must have early prevailed in the mountainous parts of the southern belt lands. As these conditions would gradually extend northward, it may be possible to accept not only the evidences of glacial action from the south, which have been found in late Carboniferous strata in our present Southern Hemisphere, but also the belief that there was floating ice elsewhere, since icebergs may have been produced of sufficient size to be carried by swift currents — everything moved rapidly in those days — as far as India, whose striated Permian rocks have been attributed to such a source, or even into more northern seas, in the vicinity of which other such rocks occur. They are not necessarily the product of local glaciation. The gradual contraction of the waist of the pear, due to a diminution of speed (see *Ibid.*, pp. 325, 327), probably led to the ultimate rupture, and the unequal cooling doubtless tended to hasten the catastrophe. It must have involved fearful earthquakes, enormous accretions of heat, melting ice, extensive submergence, and a general readjustment. The shock and the shifting of the center of gravity must have altered the motion of each disconnected part, the twist given to each body being sufficient to divert the moon from a north and south orbit into an approximately east and west one. (See below.) During the next era (Mesozoic), the sun probably began its dominant influence. An elevation of the lands in high latitudes seems to have taken place near the close with a change to a cooler climate and a loss of tropical life. (This might provide for Darwin's postulated subsidence in the ocean bed to account for the formation of coral atolls, for which evidence has been lacking.) The next age (Tertiary) also shows instability, and it seems likely that the moon was partly responsible for these crust movements, since it must have been considerably nearer the earth than it is at present during both ages. (Of. *Ibid.*, pp. 3, 101 ff., 273 ff.) A general elevation in high latitudes seems finally to have taken place, and a long period of stability followed. The earth appears to have been at Aphelion during the northern winters, and this gave opportunity for the accumulation of enormous masses of snow and ice before the final dispersion of what now remained of the cloud envelope, which must have persisted to a greater or less extent for many ages in some localities, just as similar cloud caps now persist on other planets of our system. Isolated areas of glaciation, some of which may have existed during several previous eras, were thus merged into true ice caps on different continents, and these produced the Glacial Epoch.

three things, then,—the deeper ocean basins, the reduction in the amount of their contents, and the greater height of the land,—explain the cañon-like extensions that are found in the bed of the sea at the mouths of some rivers, since, taken together, they must have greatly lowered the ocean itself as modern nations know it. They also explain the fiords of Norway, although it may be necessary to postulate the action of glacial ice to account in full for their formation. Other results of the conditions named would be the joining of the British Isles to the continent of Europe, the draining of the shallow water west of Gibraltar till the Mediterranean was cut off, the depletion of the latter's waters until a great marsh inhabited by countless hippopotami extended from Africa to Sicily, the uniting of the two Americas by the Antilles, and the merging of the continental islands of Asia with the mainland; all of which things unquestionably took place in Pleistocene times or during the Ice Age.

Such, in brief, may have been the story of the Glacial Epoch up to its culmination. Any theory which attempts to deal with this period should adjust itself to all the facts so as to form an integral part of a consistent world history. The claims of Astronomy deserve recognition as well as the laws of Physics, and geological evidences must be squared with other evidences of every available sort. Even the infinitesimals ought not to be ignored, until the equation nears its final solution; for no single science, taken by itself, is equal to the task involved. This should be clear, although questions concerning minor points may still be numerous.

Details can be worked out only after long and patient study by many investigators; but general principles do not change. Glaciers of gigantic proportions once existed in various parts of the earth, and they had an adequate cause or causes. Their

effects must have been far-reaching, and their ultimate destruction cannot be accounted for in a satisfactory way, unless some force or forces equal to the task can be made apparent. Modern glaciers do not prevent a temperate climate in their near neighborhood, and, in spite of their extent, it is not unreasonable to suppose that in those days a temperate climate on both continents was to be found in close proximity to the ice fields. Such a climate must have existed, in point of fact, to account for the melting ice and its resulting formations along the borders of the glaciated areas. It involves no real difficulty. But what of conditions in Asia?

Large portions of Siberia show no appreciable signs of an ice cap; but these districts are low-lying and appear to have always been so, and warm ocean currents directed against the Asiatic shore may have entailed effects similar to those now produced by the Chinook on our western coast or the Föhn of the Alps, both of which consume snow and ice like hoarfrost. To these probable causes may be added a lack of excessive precipitation, except, perhaps, in the extreme northern portions; for warm air currents, coming from the sea, pass over low-lying lands without depositing their moisture, until they are compelled to do so by a change of temperature. In the extreme northeast and the extreme northwest Siberia shows signs of glaciation, as do some of the mountain ranges and some of the highlands of Central Asia. It is therefore probable that this continent also had its share of ice, although some of the higher regions in its southwestern portion were probably exempt.¹

There is a limit to the endurance of the earth's crust, and Dr. Wright has called attention to this fact. Evidences of submergence were abundant; but a cause appeared to be lack-

¹ See J. Geikie, *The Great Ice Age* (Third Ed.), pp. 691 ff.

ing. He has supplied it by showing that the enormous weight of the accumulated ice and snow constitutes a *vera causa* in the premises. Ice averaging a mile or more in depth must ultimately break the back of a continent and drive it downward into the plastic portion of the earth's interior. Vast quantities of water had been taken from the ocean, and a corresponding weight had been removed from its supporting bed. The land groaned beneath its load and probably began to yield, slowly settling for many a decade as the snow increased. At last there came a time when it could bear no more. It then gave way and sank steadily downward with increasing speed. Submergence was the result.¹

But what of its effects? The laws of Physics cannot be evaded, and they must apply here. First, however, let it be said that Dr. Wright has exacted no toll for ice in Asia or in the Southern Hemisphere. He did not need to do so to prove his point; but there are other elements in the problem. The ice now stored in the Antarctic regions is said to be sufficient, if melted, to add many feet to the present depth of the ocean. There must have been ice in that part of the world at the time under discussion, and the snow which formed it must have come from the ocean by evaporation. The same is true of the ice in Asia, and in each case every ton of ice represents a loss of pressure on the ocean floor, precisely as it did in the other instances.

In the Southern Hemisphere the earth is now nearer to the sun in summer than it is in winter; but this condition was reversed some ten thousand five hundred years ago. The Northern Hemisphere then received an excess of heat in the short summer months and an excess of cold in the long winter

¹ See G. F. Wright, *Scientific Confirmations of Old Testament History*, pp. 220 ff. Translations of this book are rapidly being made.

ones. Trade winds and ocean currents must have been affected, sudden fogs and mighty snow-storms must have fostered an ice cap at the southern pole, as they now foster one in Greenland, and whatever ice there may have been on the other lands of that hemisphere must have tended to persist even after the sun had become the dominating factor in the world's climatic conditions; for continental ice had probably accumulated there also to a considerable depth, where conditions were favorable, since the cloud cap must have had some effect in that part of the globe as well as elsewhere. The Greenland summer sun is hot and it shines incessantly; but the ice cap is not melted. Fog and the lack of land areas to radiate the heat are the causes of this, and the same thing must have been true of the Antarctic ice pack ten thousand years or more ago. Even now, at Perihelion, the cold of the Antarctic summer is intense at times, as all explorers testify.¹

Signs of glaciation are found in Patagonia and the Andes, in the mountains of South Africa, in New Zealand, and in the Australian Alps, in connection, apparently, with Pleistocene remains. This is as it should be theoretically; for the sun was largely powerless even with a warmer ocean to reinforce its efforts, since it was blanketed by the fog and the clouds. Warm air currents from the great expanse of sea probably hindered the growth of the glaciers to some extent; but they favored their preservation by an excessive evaporation, and the southern seas were steadily cooling in those days. They received less heat than they now do, while the northern seas received more. The Arctic Ocean was thus probably much warmer than it is at present, and this may account, in part, for the fact that the centers of the northern ice formations were so far south of the pole itself.

¹ See J. Geikie, *The Great Ice Age, l.c.*, pp. 800 f.

Taken altogether, the ice in the Southern Hemisphere combined with that in Asia must have equaled in area the glaciation of Europe and North America, although it was hardly so deep on the average in all probability. It was there and it was there during the Ice Age, according to the evidence. To estimate its bulk at one half that of the ice caps of Europe and North America cannot be excessive; but that means that the total number of tons of water taken from the ocean exceeded, by one half, the entire amount of ice on the two continents last named. If either of them sank, as has been suggested, this fact is of importance; for something had to give way upward when the land went downward.

Although it now seems likely that the earth's interior is practically a solid mass, because the pressure must make it so; it is clear that it must also be a viscous one for many miles beneath the outer crust, since, if it were not, the seismograph would not operate so effectively. As it is, slight earthquake shocks are registered many hundreds of miles away; for the resulting vibrations impinge on the solid surface with sufficient force to cause it to transmit waves of two kinds. The first are now believed to be waves of compression depending on a change of volume; while the second, which are slower and more violent, are supposed to be waves of distortion due to a change of shape.

But if a slight earthquake produces such a commotion in the mobile portion of the globe's interior, what would a sinking continent do? The removal of pressure leads to liquefaction in volcanic vents, and molten rock and boiling mud are then ejected. It follows that a similar condition might be caused within the earth, if the pressure were sufficiently reduced. A result approaching this may actually have

occurred at some time in the past, and it may even have occurred in this connection, as will now be shown.

The first result of the pressure, combined with other causes, which was induced by the increasing accumulations of snow was doubtless the great activity in the volcanic belt, that was characteristic of late Tertiary times. The slight settling thus indicated seems to have added to the rigidity of the continents, and this appears to have been still further augmented by a later settling which resulted in the final upheaval of the Himalayas and the neighboring plateaus, an event which must apparently be assigned to early Quaternary days.¹ A snow cap soon began to accumulate on the mountains thus recently elevated; but it never attained to any size, since it lacked the opportunity. Because of this increase in the stability of the continents, the great ice caps became a possibility; but, when the accumulations had reached a certain point, the effect of their enormous weight was tantamount to an upward thrust, too powerful to be longer resisted; and this must have been chiefly felt by the weaker portions of the ocean bed, because it was now deprived of too large a part of its load to retain its stability.

There could be but one outcome. They gave way upward, as the abundant evidence already given testifies. The natural consequence was a diminution of pressure in the earth's interior and an enhanced mobility. With its support thus largely reduced, the weaker continent would begin to sink. The other would almost certainly follow, though with consequences that would be less conspicuous. Both would be carried downward with increasing speed, until the disaster became a fearful cataclysm. Other glaciated areas would feel the shock; but,

¹ Cf. *Enc. Brit., l.c.*, vols. xi. pp. 824 ff; xii. pp. 735 ff.

as their instability was comparatively slight, they would suffer accordingly.

The consequences of actual submergence must have beggared description. As the continents sank, huge rents, torn in the solid crust, could not fail to belch forth molten lava and volcanic mud, while every crater on the globe would tend to add its contribution to the awful chaos. Land adjoining the depressed portions would be carried downward to a greater or less extent; and, at the outer limits of the most pronounced submergence,—because of the bending to which the crust would be subjected,—fissures and clefts, such as are found in Southern Europe, would be opened in the rocks and hardened earth. Some of these would be left. Others would be filled with molten rock because of their greater depth.

But “Action and reaction are always equal”; and, with the culmination of the upward movements in the ocean floor, a rebound would be sure to take place on the part of the two continents involved. Months, if not years, would have to elapse before the terrible “seesaw” thus begun could terminate and a condition of stable equilibrium be restored. In the meantime the commotion in the sea would also be prolonged. Forced skyward by the initial uplift, its waters would necessarily be sent landwards with increasing speed and violence, as the catastrophe progressed; and a constantly augmented tidal wave would thus be driven towards and over the continents, until the inevitable reaction took place. A return wave would then be produced, and the fearful ebb and flow would continue, until a balance could be struck, as the inequalities of pressure were gradually overcome. But what of the submerged ice packs?

Broken into huge bergs in some places; ground into countless fragments in others; assailed from beneath by the

terrible heat of molten lava, volcanic mud, and superheated steam, from the earth's interior; torn asunder by the impact of the tidal waves; tossed about by the heaving earth, until they came to the surface of the rising deluge to augment its tempestuous waters:—what chance did they have? They could bid defiance to the sun, entrenched as they were, but not to the allied earthquake, fire, and flood. The heat set free through the ruptured crust must have been enormous, to say nothing of that engendered by the friction of the “faulting” rocks. Even the conflicting bergs, some of which must have been dashed together with tremendous force, may have produced friction enough to develop a little heat, which could but hasten their melting and final dissolution.

Great as the ice accumulations certainly were, hardly a trace of them would survive, save in exceptional instances, including certain low-lying fields which would be likely to be deeply buried beneath loose earth, washed over them before they had time to break loose from the frozen ground and come to the surface. Lands which did not sink would also be involved; for hardly any part of the globe could fail to be affected, to some extent at least. The Lisbon earthquake of 1755 produced a tidal wave fully sixty feet in height, which went rushing inland. What, then, was the ultimate height of this tidal wave, generated by such titanic forces? It may have begun gradually, and it doubtless did; but, as it increased in violence with the augmented upward thrust, it must have attained to gigantic proportions; and, if it did, it must have been carried over everything but the peaks of the highest mountains, with some possible exceptions in Central Africa, Kashmir, and Thibet. The ice of the Southern Hemisphere would thus be destroyed, including even that of the Antarctic regions; the great mammals of South America would perish, with those

of North America, Europe, and most of Asia, as the evidences show that they did; and the story of Noah and, in part, the other tales, previously outlined, would be justified.

If allowance is made for the topography of the Euphrates valley, the experiences of Noah, as they are depicted in the Bible story, will not appear to be exaggerated. Genesis has, in fact, but baldly stated them. Weird as are the tales of the Druids, solemn as are the narratives of the Chinese, and fanciful as are the legends of the Greenlanders, they all contain elements of truth. This is not too much to say; for the facts seem to fully warrant it. In places, the land must have been greatly broken or "tilted over" by the subsidence; and it was in just such spots, far enough away from the glaciers to make animal and vegetable life possible, that men were likely to be found. Nor is it unreasonable to suppose that some volcanic action attended such phenomena, and that men beheld its results.

How many of them survived is a problem; but it is certain that they were few in number and of superior intelligence. Genesis does not necessarily imply that every human creature outside of Noah's immediate family was destroyed; for it has to do with the world as its author knew it and not with the earth of modern Geography. It tells the facts as they occurred in the region where Noah lived; but it goes no further. It is unreasonable to expect it to do so. The voyage inland and northward, the swift drifting for hundreds of miles, the obliteration of the mountains by the breaking up of the "fountains of the great deep," the torrents of rain, the gruesome horror, and the final stranding on the Mountains of Ararat after being swept back and forth for many days, are all true to the life; for they portray exactly what ought to be expected under the circumstances. A flood was the only possible out-

come of the peculiar geological conditions, all of which have left behind them abundant evidences of their reality. Is it reasonable to maintain that the Bible story is an account of a local disturbance, confined to the Euphrates valley but exaggerated by an excited imagination? Was it a myth?

That the melting of the glaciers occupied but little time, comparatively speaking, must be clear. Such a conclusion cannot be avoided, and it incidentally solves one of the most puzzling features of the deluge problem; namely, How was a universal flood possible, if fresh water life, both plant and animal, was to survive? The melting bergs took care of that; for they made the adjacent waters so dilute that they were no longer "salt." Carried backward and forward by the alternately advancing and retreating flood, they continued to melt, until they either disappeared or were stranded on the rising land in spots remote from their place of origin. The waters that covered the continents were thus kept comparatively fresh, and some influence was exerted by the melting ice even in sections far remote from the glaciated areas. Fresh water produced in this way often floats for many days on top of the heavier brine beneath, as northern explorers have found to their cost in impeded progress; and, in this manner, the shifting surface seas must have been kept much fresher, even at great distances from the ice packs, than the saline character of the ocean depths would appear to warrant. By these contingencies the last stronghold of the opposition is destroyed, and a way is opened for a broader and more comprehensive view of this entire subject.

The ocean basins finally became somewhat stable; but neither continent was restored to its ancient level. Each was left in a position lower than the one it formerly held and in a position favorable to a temperate climate. This was due, in

part, to changes in the ocean itself. Its bed was less deep, on the average, than it had been in former ages; for its elevated portions could not sink back to their old positions so long as the continents failed to rise sufficiently to give the required room. To this must be added the great increase in its bulk, due to the melted ice. For these reasons the surface of the sea must have been left considerably higher than it is at present. Low-lying lands the world over would thus be affected, and many large tracts would be submerged.

The great Caspian basin was full; but the melting ice had left its waters fairly fresh, while Gobi was probably filled to the brim with seawater. The lakes and rivers must not be forgotten; but they could not have helped Gobi to any great extent, when the fearful tidal wave came sweeping inland, and the melting ice was not sufficient in quantity to protect it. Its waters must therefore have been fairly salt. Many great depressions in North America seem to have fared as the Caspian did. With the enormous evaporation from these shallow lakes and seas, the precipitation must have been far greater than it is at present; but the ocean would tend to maintain its level for a considerable time, even after the glaciers and polar ice caps of our day had begun to form, since the silt washed into its basins must have covered vast areas to a greater or less depth in the course of the succeeding centuries. Terraces and raised beaches, found in different parts of the world, would seem to indicate that this was at least two hundred and fifty feet above the present limit. In various parts of the world changes of level of a recent date must be allowed for; but the figures given appear to be conservative. The Mediterranean and the sea which filled the Sahara must have been affected by the drift ice, and their waters were probably brackish for many decades.

In Europe and North America a sort of neutral ground, such as is now found in Greenland, must have existed between the ice packs and the sea; for the winds, coming in from the warmer waters, would tend to melt the ice for a considerable distance inland. The sinking continents probably caused the nearer portions of this neutral belt to bend downward to some extent, and the curious table-lands of the North Atlantic coasts may have been produced in this way, at least in part, since the chance that there was a return to former conditions is slight. The result was, in each instance, a sort of terrace along the borders of the continents. Whatever their origin may have been, these terraces were no longer dry land. They were now completely covered with water, and water has an equalizing effect on temperature. It absorbs vast quantities of heat; but it does so slowly. It gives up its heat with the same reluctance, and that is one reason why the North Atlantic allays the summer's excessive warmth and mitigates the winter's bitter cold along its borders. It lags for months behind the land in its changes of temperature, and climatic conditions vary accordingly. Extremes are thus prevented on the continents by their encircling seas, while the islands are given a remarkably even climate.

Whatever glaciers may have been left in remote and inaccessible mountain fastnesses, probably involved but a small percentage of the ice formerly on the earth's surface. The rest was melted in the sea, and the fact must be allowed for.¹ When the foundations had once been laid for the ice accumula-

¹ This can only mean, relatively speaking, that all land altitudes were diminished after the Glacial Epoch, since a higher ocean must involve continents proportionally lower. Ararat is therefore relatively lower than it was in Noah's day, although it has probably suffered no actual change of position with relation to the earth's crust.

tions of modern days, they continued to develop, doubtless with increasing speed for a time; but in the courses of the ages a change took place. The accretions certainly began to diminish with the reduction that took place in the volume of water, particularly that in shallow places, which was especially subject to evaporation; and, in time, the ice attained to such proportions that a balance had to be struck, because only limited areas were now under its dominion. Forced outward and melted at its edges, or broken off in huge masses, where it was in contact with the sea, it began to return most of the water that it had absorbed; and the ocean, helped somewhat by the silt emptied into it by the rivers, thus tended to remain nearly stationary. This appears to be its condition at the present time. It has not always been so, and the atlases of ancient geographers may be less ridiculous than they have been made to appear. Incidentally, it becomes clear that the ocean, and therefore the Red Sea, could not have been reduced in the days of Moses to its present level. The modest contention of Dr. Wright that the waters of that sea, as indicated by raised beaches in its neighborhood, may have been higher at that time than they are now, accordingly becomes more than a possibility. It is, in fact, a practical necessity. His conclusions are supported by Kiepert's Atlas, a most excellent authority; and, whatever questions may remain concerning details, his general position with regard to the crossing of the Red Sea by the Israelites is certainly sound.¹

Many other points remain to be considered; but they must be left for subsequent treatment. In the meantime, let it be said that not a single one of the geological puzzles, enumerated above in outlining the problem, is left without an adequate explanation, provided the events of the Glacial Epoch

¹ See *Scientific Confirmations of Old Testament History*, pp. 87 ff.

have been correctly outlined. Even the seals are accounted for, since ice floes from the north, and therefore seals, could have been swept inland over the Siberian plains and carried into the two great basins where Arctic seals can now be found. As to the shells on the Skagerak, it is plain that the general disturbance, caused by the upheaval, and the rushing waters, confined as they must have been for a time within a comparatively narrow channel, are enough to account for what took place.

The only real difficulties, apart from some matters affecting Noah which will be considered later, are connected with the inland seas. There is no room for these matters in the present discussion; but they will also be taken up in due time. To make what has preceded clear, a brief summary will now be given, based on Astronomical, Geological, Physical, and Biblical considerations; but it must be remembered that scientific data, so-called, are more or less unstable. Results are therefore tentative, as, in fact, they usually are.

Archæan Age — GENESIS, 'DAY ONE.' Matter in a nebulous state, but breaking up into Solar and other systems; Nebulæ become more and more phosphorescent; Earth gradually assumes definite form, molten, pear-shaped, and self-luminous; Water exists as vapor only; Outside crust begins to form and to wrinkle; Sun and stars continue to be somewhat nebulous (size counts in this problem: see Lowell, *Mars as the Abode of Life*, pp. 9 ff.).

Silurian Age — 'DAY SECOND.' Earth cools and slackens speed: Vapor condenses into a vast cloud mantle above and incessant rain beneath; Water begins to accumulate; Crust wrinkling increases; Water-plants appear; Invertebrates follow; Rock-making goes on apace (it continues with diminishing speed in subsequent ages); Sun and some of the smaller stars take on definite shape.

Devonian Age — 'DAY THIRD.' Earth continues to cool; Speed diminishes; Wrinkling increases; Oceans are outlined; Dry land extends; Vertebrate fishes develop; Land vegetation begins; Clouds and rain persist nearly everywhere; Sun becomes fairly

luminous; Some stars begin to be so; Pear-shaped earth tends to bulge towards the pole of the larger end; Small end loses much of its vapor.

Carboniferous Age—'DAY FOURTH.' Sun becomes brilliantly luminous; Certain stars begin to be visible; Others are still nebulous; Earth becomes fairly cool; Vegetation increases to excess; Instability of land and sea; Coal measures begin to form; Unceasing fog, rain, and clouds, save in limited areas and at the small end of the pear; Snow and ice accumulate near small end on the high portions of the belt lands; Small end loses its vapor and most of its sea; Speed about the center of gravity becomes too slow for stability; Pear begins to elongate in consequence and to contract its waist; Ocean beds settle as this progresses; Large end contracts laterally in the process, producing Appalachians and extensive "folds" in the rocks; Pear assumes an hour-glass shape; Rupture follows; Meteorites are formed as the elongated neck of the hour-glass parts and its molten core is scattered in fragments through space; Earth and moon each assume a globular shape; Great disturbances and changes in both; Enormous loss of life; Antarctic lands are formed; Volcanic activity in those regions and great accretions of heat; Extensive submergence of former land areas and destruction of glaciers; Tropical climate everywhere; Equatorial clouds begin to disperse; Polar clouds and probably some others follow; Moon begins to revolve about the earth in close proximity to it, but far enough away to maintain its shape, in a general way, and not go to pieces.

Note. According to Professor Darwin, pear-shaped bodies, so far as such forms have been investigated, seem to be stable within certain limits, but to lose their stability with their speed of revolution. (See G. H. Darwin, *The Tides*, pp. 325, 327.) The process of parting appears to follow the lines indicated. In the case of the earth and moon, the shock produced thereby, combined with the creation of an independent center of gravity within each of the newly formed spheres, must certainly have altered their relative positions and affected their future movements. For this reason, it is probable that the earth's greater eccentricity in former ages, its inclination to the plane of the ecliptic, its variations of axis in the past with reference to that plane, and the moon's orbital inclination to the plane of the ecliptic, which produces its peculiar spiral course, together with its revolution in an eccentric and approximately west to east orbit,—instead of in a north and south one such as was to be expected from its place of generation,—are all to be traced, in some measure, to this one original source, although all these

things have been influenced and are still being influenced by the attraction of the other heavenly bodies. (The pear probably revolved about its center of gravity in the plane of the ecliptic, the rotation on its longitudinal axis being a secondary motion.) Untold centuries were consumed in the above-mentioned events; but it will not do to postulate too much time, since "astronomers and physicists, headed by Lord Kelvin, would limit" geological time "to 24,000,000" years. (See *Bibliotheca Sacra*, vol. ix. pp. 31 f.)

Mesozoic Age—'DAY FIFTH.' Rains continue; Clouds break away in fresh places; Sun begins its dominating influence; Snow forms on lofty peaks in high latitudes, where such peaks exist; Huge reptiles appear (Genesis implies that there was a vast increase of marine life already existing, a further development of bird life, and the creation of great sea monsters, quite in accordance with the teachings of Geology); Land continues to be very unstable, the moon's tidal influence being enormous; Mountain-making goes on extensively; Climate changes somewhat; Tropical life disappears in many northern latitudes; Seasons begin to develop; Conifers and palm-like trees abound; Tidal friction gradually lengthens sidereal day; Moon's rotation is much retarded by the same force; Great volcanic activity in India, the Andes, and Western North America; Marine life is largely exterminated, apparently by the development of cold currents in the sea.

Cenozoic Age—'DAY THE-SIXTH.' Tertiary Period:— Clouds and rain continue; Sunlit belts widen; Seasons become fixed; Ocean remains comparatively warm but grows slowly cooler; Temperate climate persists in the Arctic regions near the coast; Snow and ice are found inland at high altitudes, except, possibly, in the tropics; Great mammals appear (Genesis seems to refer to an increase of the life already existing as well as to the creation of new forms); Fresh disturbances with volcanic action, due partly to the moon's continued though lessening proximity, but helped by the internal pressure produced by the accumulating snow; Continents settle and gain somewhat in rigidity; Mountain-making nears completion; Day continues to grow slowly longer; Modern trees appear; Ice caps begin to form.

Quaternary Period:—Man is created; Cloud caps persist in limited areas; Rain abounds; Heavy snows in high altitudes and high latitudes; Snow attains great depth, especially in Europe and North America; Readjustment ensues; Himalayas are completed; Glaciation increases; Sea is more and more depleted; Continents are more and more exposed; England be-

comes a part of Europe; Antilles join North and South America; Japan, Ceylon, Australia, etc., become parts of Asia; Europe and Africa are united at Gibraltar; Mediterranean becomes in part a marsh; North America and Asia are joined at Bering Strait (Alaska seems to have had but little ice at that time); Coast gorges are cut by North Atlantic rivers; Flords are deepened by glacial action; Palaeolithic men become widely distributed (conditions were everywhere favorable to this as no boats were needed); Sidereal day continues to lengthen but very slowly; Moon becomes rigid as the time of its rotation is reduced to once a month by the tidal friction produced by the earth's attraction, and such friction then ceases; Ocean floor grows more and more unstable from the loss of untold tons of water; Weak spots begin to give way upward; Europe (glaciated portions) settles rapidly; North America follows; Upheavals become more pronounced; Earthquakes abound; Tidal waves are generated; Continents sink steadily (probably as the culmination of a long period of settling, as Gen. vi. 3 indicates); Flood-like rains begin; Tidal waves increase in violence and begin to cover the land; Other glaciated areas are affected and rendered more or less unstable; Submergence continues to spread; Tidal waves become very violent; All the continents are affected, but high mountain peaks in some places, Central Africa, and parts of Asia escape because of their conformation; Land animals are mostly exterminated; Some escape in favored places; Reaction begins after a number of days (Genesis vii. 4, 12, would make the time forty days); Ebb and flow continues for many days (Gen. vii. 24 implies one hundred and ten); Readjustment continues for months with a gradual cessation of the flow and a lowering of the waters; Glacial ice is melted in the process; Reëlevation of the continents accompanies the receding movement of the sea; Equilibrium is reached with parts of the continents lower and parts of the ocean bed higher than they were before; Glacial Epoch ends.

Note. Much has had to be taken for granted, especially in this brief summary; but attention has been called to the fact that, while the ice areas diminished somewhat in extent by losses along their comparatively thin edges, they increased in depth and therefore in weight elsewhere, especially toward their main centers. Pressure was thus more and more concentrated on a slowly shrinking base, while the load on the ocean floor was growing lighter because of the constant drain produced by the accumulating snow. When the increase of pressure had decidedly accelerated the glacial flow, the ice areas may have broadened somewhat; but this had no appreciable effect in

checking the final catastrophe, which such conditions naturally led to, since the other continents, including the Antarctic, were increasing their load all the while, and were thus adding to the instability of the ocean floor, as each ton of water was abstracted from the sea. Readjustment was inevitable, and this ultimately led to submergence. The same thing may happen to Greenland some day; for it has been slowly settling for the past six centuries under its load of ice. Calculations based on the earth's motion seem to show that its crust is thickest about the poles, and this may affect the outcome, especially in Antarctic regions where the ice pack is now enormously thick, although a Perihelion summer prevails there. Croll's theory fails to work at all in that region, and it fails to work on cloudless Mars in spite of the excessive eccentricity of the planet's orbit. The cloud-cap factor is the important one. (See Lowell, *l.c.*, pp. 112 ff.)

The submergence of the Quaternary Period, which ended the Glacial Epoch, was the Noachian deluge. It involved all lands to a greater or less extent, but it was most destructive where the earth's crust gave way, either upward or downward. The ocean was vastly increased in volume by the melting ice, and it attained a level much higher than that now reached by it. Extensive areas of what is now dry land were covered. Inland seas of enormous size were created. Loess and gravel were scattered far and wide. Drowned animals and other things were buried and so preserved. Marine animals were stranded on high places. Clefts were opened and later filled with animal remains washed down as the sea retired. The whole world, indeed, was changed. Details may need revision; but such, in general, was the flood. Through the few who survived its terrors, it has left its imprint on the literature and legends of all nations save the Blacks, and the evidences of the havoc which it wrought have been traced in many lands. It was no myth and no local disturbance but a far-reaching and intensely significant reality.

CHAPTER III.

THE SURVIVORS.

It has been commonly supposed that Noah landed on Mount Ararat. The Bible does not so teach, however; for it does not say, "Ararat," but, "the mountains of Ararat," referring, evidently, to a district. The fact that Mount Ararat has two peaks, one about forty-five hundred feet lower than the other, does not justify the assumption that this particular mountain was meant by the Bible expression, although the name has survived as a designation for the two peaks in question. It therefore seems clear that the words are general in their application and not particular. They probably have reference to some indefinite point on a range of mountains in Armenia, in a region then known as Ararat, which may have included the present Ararat, the name having ultimately survived as a designation for the most conspicuous mountain in the neighborhood. Strange as the landing seems, — inland, up-stream, and some hundreds of miles northward from the point of departure, — it is by no means inexplicable, if all the facts are considered.

The Persian Gulf has a narrow entrance flanked by headlands, beyond which it broadens out into a bay of large dimensions. This is a dominating factor in the problem; for the first tidal waves from the Indian Ocean had to pass through this narrow inlet and then spread themselves over the surface of

the great basin beyond before they could reach the Euphrates valley. When that point was finally attained, their fury was spent; and, while they must have continued to rise with a rapidity that was frightful, their power to destroy by violence had been reduced to a minimum. The ark was therefore lifted by the advancing flood and not wrecked by an avalanche of water. As the upheavals grew in power, the tidal waves were also intensified; but a floating vessel would be carried forward with little danger from that particular source.

Before each wave culminated and began its return, a new one probably overtook it and forced it onward; and, in this way, the "head" finally became sufficient to carry the water, and the ark, over the highlands of Armenia, beyond which other waves from the Atlantic by this time must have begun their work of devastation. Somewhere in the general region of the Black Sea, whither the strange craft was probably wafted, the inevitable reaction finally took place, and the ark must then have been carried approximately in the direction of the strongest current. It is not necessary to suppose that Ararat itself was sighted in the upward voyage; for it would seem to be too far to the eastward to be in line with the natural movement of the waters under the conditions mentioned. It is therefore not necessary to conclude that it was covered at all; for the "high mountains" of the revised text—the old version has "hills"—must be the mountains within the horizon of the observers in the floating ark. This is plainly the meaning of Genesis vii. 19,¹ and the conclusion is obvious.

¹ Even in verse 20, where both versions have "mountains," the Hebrew word is the same (*har*). It means "mount," "hill," "hill country" (cf. Josh. xiii. 6, where the same word is used in the original), and it is not well to force this term by assuming that it means more than it says, for Oriental languages are not given to understating facts, while they do lean to Hyperbole. The same

According to the story, all the high hills and the mountains were covered; but the mountains were those within their range of vision,—they could not have known about any others,—and these probably disappeared from sight one after another beneath the waves, as they were swept towards them by the advancing flood. Other and higher mountains were not necessarily submerged, and Ararat may have been of the number. Awful breakers took the place of submergence for these.

The Genesis narrative implies that the ark drifted for many weeks after the catastrophe, which seems to have occupied forty days from its beginning to its culmination. For one hundred and ten days after that, things were trembling in the balance, so-to-speak, and there was a ceaseless ebb and flow. Readjustment then began and continued for many months. It was accompanied by a change in the weather according to Genesis viii. 1–3. Some combination of conflicting currents now swept the ark far enough to the east to strand it at last on a mountain in the region described above, which is recognized by Kiepert's "Atlas Antiquus," although no Mount Ararat is found in that excellent authority.

In the meantime the released ice had contributed enormously to the bulk of the shifting waters, and this had kept them deep enough to cover the high hills and even some of the mountains,

word (*har*) is used for mountains in the rest of the narrative. Although it is rendered "mountain" over four hundred and fifty times in the Old Testament, it is also rendered "hill" more than fifty times. The true content of the Hebrew term is the only sound basis of judgment. This story was not written primarily for men of the twentieth century, but for the ancient Hebrews. How, then, shall it be judged,—by modern educational standards, or with a due regard for the limitations and restricted ideas of the men for whom it was originally intended? And if it has a broader application, as this story undoubtedly has, is that application primary and fundamental, or secondary and incidental? In these matters there is room for thought and improvement. (See below.)

because the affected portions of the ocean bed had not yet begun the process of settling to their present level from the elevation at which they had been left by the successive upheavals. The level of the sea had to correspond, and the inordinate precipitation had added its quota to the swollen waters.¹ The problem of where so much water came from is therefore not difficult to solve. As it subsided and the fog and the mist dispersed, the tops of the mountains gradually became visible, and a little more than a year after the date of their embarkation the survivors left the ark to begin life anew.

As to the notion that Noah had living specimens of all the world's animals — carnivora and herbivora — in his vessel, it is perhaps enough to say that he probably had a sufficient task on hand in the construction of his ship without taking a trip on foot to Europe, Asia, Africa, Australia, and the two Americas, none of which can have been known to him, to gather and drive to the Euphrates valley animal pairs from all parts of the earth against the day of his embarkation. Comment is unnecessary. The language refers merely to such animals as he was able to find in his own part of the world, and the expression "all the earth" means only what was to him all the earth. It could not signify the earth of modern Geography, or much more than the narrow limits of Mesopotamia, which certainly embraced "all the earth" from his standpoint.

The animals of that region, then, were the ones which he collected, and the behavior of wild or semi-wild creatures on the eve of a great convulsion of nature is known to be such that they can be handled in a manner quite impossible at other times. Noah was not given a command that was beyond his powers of accomplishment, although popular notions on this

¹The appearance of a rainbow may have been due to this loss of a cloud cap, which was now destroyed sufficiently to permit it to be seen.

subject involve a task far greater than the fabled labors of Hercules. Indeed, they really involve one that was quite impossible of achievement, except by the aid of a stupendous miracle, requiring a vast and unnecessary waste of energy, a thing of which God is never guilty.

The great mammals of Europe perished in the flood. So did those of the Western Hemisphere. For the most part the carnivora and the herbivora of these regions were simply exterminated. So were those of Northern Asia, and it was certainly for the good of the coming Neolithic race that this was so. A few may have survived in the mountains. In Asia, in particular, such an event seems to have taken place; and it may be that elephants and some other tropical animals were still able to live in Kashmir and Thibet, where they certainly abounded at one time when those lands were apparently at a lower level than that which they now occupy.¹ In Africa, the elephant, the hippopotamus, and the rhinoceros with other animals appear to have survived, and the cause is not far to seek. The conformation of the highlands near the coast is such that the flood must have been turned back upon itself and the tidal waves broken so effectually that they were unable to reach the great central table-lands and plains of the interior,² although vast sections of the continent in the north and west were submerged along with Europe and the rest.

But if animals survived in some of these remote regions, men may have done so likewise. The Bible language does not forbid such an assumption, as has already been suggested; for even our own matter-of-fact and literal English allows its users

¹ It is not impossible that they were still at a lower level than the present one and that their final elevation occurred at about this time. See *Enc. Brit.* (Ninth Ed.), vol. xi. p. 828. The common view has already been given.

² This may account for the lack of a flood legend among the Blacks.

to say, "Everybody knows," when only a few of one's intimates really do so. Again, "All the world was there" means merely that a respectable number of one's neighbors was observed at some local function. It does not imply that the entire population of the earth was present, and it would be absurd to take it so. "Everybody says so" does not even include all the inhabitants of one's native town or his place of residence. It merely means that Thomas and James and Peter and possibly a few other personal friends have casually made the same remark. Such forms of statement are typically Oriental; but the matter goes deeper than that.

All Noah's world really was affected, though his world was not our world; and, while all our world was affected too, the fact was beyond his ken. Of his world all that is stated was literally true, and it should be so taken. His account of the events was doubtless handed down to his posterity, and it probably reached the author of Genesis by direct tradition through the descendants of Shem. Beyond Noah's world the words did not and could not then apply; for no user of language can consciously put into it more than he himself knows. He may be led to use a form of words which can mean far more than he realizes; but that is beyond the scope of their original or local application, and it is therefore a secondary matter so far as he is concerned. The presumption is that it is also secondary so far as others are concerned, and the burden of proof lies with those who wish to reverse this arrangement.

Language always contains these possibilities; for no two persons ever use it with precisely the same limitations. The meaning of each individual word is a composite, with sharp central features and a nebulous border; and even then forms of expression may sometimes vary beyond their natural or prescribed limits. Hearing some amazing tale, a German may

exclaim: "Das ist Geschichte!" Its English equivalent, 'That is history,' reproduces its form with accuracy and precision; but it utterly fails to represent its content. Translation, in fact, is impossible; for the meaning is the same as that of the English slang phrase "That is a whopper!" The content of words is always affected by their environment and by the limitations of their users. For this reason care should be taken in interpretation not to overstep the boundaries set by the circumstances and the individual knowledge of the particular speakers or writers. If exception is to be made, there should be ample grounds for it, and even then the two meanings should be clearly differentiated so that the double application may be plain.

This general principle applies in many Bible passages besides the one in question, and it is well to recognize it. When Genesis makes Cain say (iv. 14) that he is driven out from "the face of the earth," — the revision has "ground," — it is plain that his home lands are all that he could have had in mind. He could not even conceive of the entire globe, unless all our ideas on this subject are false. So "all the kingdoms of the world upon the face of the earth," in Isaiah's condemnation of Tyre (xxiii. 17), can hardly include much, if anything, beyond the countries bordering the Mediterranean. Other similar passages have corresponding limitations. Daniel varies the matter somewhat; but his "dominion to the end of the earth" (iv. 22) has a very limited range centering in the Euphrates valley. The same is true of his "people, nations, and languages, that dwell in all the earth" (vi. 25). The "whole earth" which his fourth beast was to devour (vii. 23) was more extensive, including essentially the two general regions just mentioned; but it was still a very limited earth from our standpoint. The boundaries set by their knowledge must

determine the content of such passages, not the ideas of the present day; and the language is not even figurative, or was not when it was framed, since it contained no intentional or even conscious hyperbole. To them it meant exactly what it said, and on that basis alone can it be interpreted fairly or fairly judged. What the words may now mean after centuries of growth and expansion is irrelevant,¹ and any attempt to deal with them on such a basis shows a singular lack of historical perspective, to say the least.

¹ Cf. Wright, *Scientific Confirmations of Old Testament History*, pp. 184 ff. If objection is made to these statements on the ground that they assail the doctrine of inspiration, let it be remembered that no document can claim to be inspired if it fails to meet the needs of the persons for whom it was originally intended, and no document can meet those needs unless it uses the idioms of the people with the content which they are familiar with. The Bible does not fail; for it does exactly these things, which is all that is here claimed. But it does more than this: it adapts itself perfectly to the needs of every age and people, irrespective of the shifting ideas and changing nomenclature, including the content of words, that come and go with the centuries. Under the guidance of the Spirit, the Old Testament authors wrote better than they knew; but they also wrote as they saw, and their own words and expressions were not interfered with in the process, save as they themselves were guided in so selecting their terms that the language would meet the growing requirements of succeeding ages. God never rules out the human element. He uses it. A clear vision, an intense desire to know and tell the truth, and a complete dependence upon Him, rendered these men fit instruments for the work it was given them to do. They were led accordingly; but they were not mere automata worked by wires, so-to-speak, from heaven. In some instances ancient ideas ran counter to scientific fact; but to have formulated a statement in strict accordance with the truth would have involved a lack of understanding for many centuries and a defeat, to that extent, of the purpose of revelation. The limitation was ignored and the idea was used as it stood; but that merely shows God's wisdom and patience in so shaping his teachings to human comprehension that all men can understand. The present age knows what was meant with the same precision as have former generations of men, and that is the supreme test in the premises as well as the only real necessity.

This consideration makes it clear that the survival of a few individuals outside the narrow limits of Mesopotamia may not be excluded by the Bible language; and it is therefore possible that the words, having reference, as they do, to Noah's personal experience, are to be taken somewhat as the English expressions given above are, or as is the saying "The army was annihilated," a form of words which does not deny the possibility of survivors but rather implies them. Some of the accounts introduce elements that are not found in the Bible story, but are necessarily involved in the general catastrophe, and these may be regarded, in some cases, as actual traditions, handed down to posterity by genuine survivors of the deluge. The Assyrian flood legend and some others undoubtedly came from the same ultimate source as the Bible story; but the Chinese and certain others must have had a different origin.

The Assyrian version has taken on various mythological elements in the course of its transmission, while the Bible account has been handed down in all its purity; but that does not prevent the two from having come from the same fountain head in the first place. The Chinese version, on the contrary, although it is far more sober than the Assyrian and appears to faithfully record the frightful convulsions produced by successive earthquakes, contains no ark element and differs in other respects so materially from the Mesopotamian account that it cannot be referred to such a source. It is rather an independent record, based on local conditions, but recognizing the moral elements involved.¹ The truth is that conscience is the same in all men; and, when the catastrophe came, conscience awoke. The few who survived knew that

¹ See *Bibliotheca Sacra*, vol. lxi. pp. 152 f. Some refer the story to a local flood; but it seems to have been too serious a catastrophe for that. The author has looked in vain for this version in the *Ll Ki*, *Sacred Books of the East*, xxvii., xxviii.

the destruction was deserved, and they made their inference accordingly.

In the distant north, near the coast, where the climate was still mild because of the warm sea, some man may have escaped on some lofty mountain peak, whither he may have gone in search of food, since it was now November, the time when nuts are ripe; and some woman too, bound on a similar errand, may have survived and been attracted to him later by sounds suggesting a human neighbor marooned like herself in the midst of a waste of waters on a mountain that had been changed to an island by the flood. Other similar pairs may possibly be postulated in a few instances; for the Voguls,¹ who dwell on the slopes of the Ural Mountains in Perm and Tobolsk, in Western Siberia, tell how a "great man" and his wife made two dugouts from a poplar tree and twisted a rope of willow roots, some three thousand feet in length, which was used as a cable to hold the boats to an anchorage when the deluge finally came. Skins were used as a cover, and provisions for seven days were taken in each boat, with butter to ease the cable as it was drawn outward. Taking his advice, some of his tribe did likewise, while others gave no heed. He told them that the water was coming soon; for they had already heard its roar for two days. It came; and those without boats, those whose cables were too short, and those who had no butter to prevent excessive friction from the running cables, all perished. After seven days the waters began to subside; but the devastation was complete. In all of this there may be elements of truth; for it is possible¹ that there were places where the flood was comparatively mild and of short duration. Mountain ranges in the interior of a continent far re-

¹ See Lenormant, *The Beginnings of History*, Trans. from the Second French Ed., pp. 453 f., or Urquhart, *New Biblical Guide*, vol. i. pp. 271 f.

moved from the centers of disturbance in the ocean bed might certainly favor such an outcome; for they might escape all but the culminating waves of the uplift. For this reason the Vogul story cannot be lightly dismissed. It may be true.

The vaunted antiquity of the Chinese may likewise be no empty boast; for they may be the direct descendants of Cain. He wandered to the eastward, and he seems to have gone further and further away from his home. It is therefore possible that the Dravidian and Chinese races, along with the so-called Turanians of Central Asia, may be his posterity. The Sumerians, who seem to have set the fashion of migrating westward, may also be of the same stock; for a few survivors in Kashmir and on the mountains to the west would furnish all the needed material for the propagation of the races in question. Records of the Sumerians which were made in the early days of Babylonia, days not far removed from the time of the flood apparently, contain proper names that are still common among the Dravidians of Southern India; and this suggests the possibility that the two races — if they are not really one — came from a single original source somewhere between India and the Euphrates valley.

The Hindu Kush Mountains appear to have escaped the worst ravages of the deluge, although they may have suffered some alterations from earthquakes and possibly some from changes of level. Their situation is such that survivors from the flood could emigrate without difficulty to either or both of the countries named, and they may have done so. The possibility of such a parentage for the Asiatic races as that here suggested, relieves the difficulty of accounting for their languages, since a race division in the days of Adam would easily explain the peculiarities of their tongues and the impossibility of classifying them with those of other peoples.

This field is worthy of investigation. It has never been worked, apparently.

By the time the Semites were returning to the Euphrates valley from Armenia, the Aryans may have begun their migrations, which seem to have taken them first to the steppes of Southern Russia, whence some of them finally made their way eastward into India. This part of their history can still be traced in the Vedic literature. Others went west into the rest of Europe, but Southern Russia was the cradle of the race,¹ in all probability, and Japheth was its progenitor, although it has been supposed by scholars that no connection, either historical or linguistic, could ever be shown between them and the Semites. That position must now be definitely abandoned as no longer tenable; for a linguistic connection has been established by such works as Professor Hermann Möller's "Semitisch und Indogermanisch" and Dr. A. E. Drake's "Discoveries in Hebrew, Gaelic, Gothic, Anglo-Saxon, Latin, Basque, and other Caucasian Languages," which aim to show that there is a fundamental kinship underlying the Aryan and Semitic tongues. Each of these books is wonderfully suggestive and each is profoundly significant. They forge a new link in the evidence steadily accumulating of Bible accuracy and reliability from a historical standpoint.

The first migrations of the Sumerians into the Euphrates valley may have antedated the flood; for it is certain that they were found there at a very early period. These first settlers may have contributed materially to the prevalent wickedness, and they probably suffered extermination in the deluge. Later on, their kinsmen from the east, following in their wake, may have settled, during the ages subsequent to that event, in the

¹See Schrader and Jevons, *Prehistoric Antiquities of the Aryan Peoples*, Part IV. Chap. xiv., especially pp. 432 ff.

valley of Shinar (or Shumer), where the Semites found them on their return into Mesopotamia. It therefore seems likely that they had pushed westward, as the population in Asia began to increase once more, and were building themselves cities on the ruins of ancient Semitic and Sumerian towns. The returning Semites tarried with them; but the Hamites, who apparently accompanied the Semites in this migration, continued to the south and west, making their way ultimately into Egypt and beyond.

The Semites, in their turn, now began to rear new habitations; and, in time, they borrowed the Sumerian culture and adopted their ideographs, using them as their own.¹ Both races were there, according to the monuments, and a prolonged speech contest undoubtedly took place in consequence, evidences of which can still be found. Somewhere in this general connection the Babel incident of Genesis must be placed; for the double use to which the ideographs were put, must certainly have led to confusion in the end. Here, again, the content of the Bible language needs to be carefully studied; for some things have been read into it which are hardly correct in the light of recent evidence. It was to preserve their name rather than to reach heaven that the tower was projected, and the idea seems to have been borrowed from the Sumerians, whose power they evidently feared.

The moral elements, including the pride and the conceit, were doubtless there; but care should be taken not to interpret the forms of language then used, with too much literalness. They were an intense people, prone to excesses, and their ideas and expressions must be judged accordingly. In this connection, it may be said that if there is half as much in heredity as is often claimed, the Sumerian contingent may have come hon-

¹ See Clay, *Light on the Old Testament from Babel*, pp. 89 ff.

estly by such characteristics, as the direct descendants of Cain. The Asiatic and more especially the Chinese disregard of life, including their own, may not be altogether surprising on the same basis. The possibility that a few of Cain's posterity may have survived the flood on the mountains mentioned, and on the lofty plateau near by, which has been aptly called "the roof of the world," offers a simple solution of difficulties that have long seemed hopeless and insurmountable.

If these conjectures are in harmony with the facts, the story of the ark came into Babylonia with the returning Semites, but soon became common property. It was dealt with accordingly. One thing is made clear by the Assyrian flood tablets, if they are at all reliable in their statement of contemporary facts; namely, the existence of sacred writings before the time of the deluge. Such writings, the tablets say, were to be buried in the city of Sippara (or Shurippak) in anticipation of that dire event.¹ They also state that the survivors returned and dug them up after its occurrence. It may be inferred that there were such writings, and that they were buried by the flood and afterward found by the Sumerians while they were leveling off the surface of the ruins to rebuild. The presence of these statements in the tablets must have some significance, and it seems likely that they arose from the recovery of ancient writings or sacred records in some such way as that suggested. The suspicion that we may have parts of Noah's log-book is therefore not without foundation, apart from the internal evidence,² for, in addition to the above facts, it is clear that the art of writing must long antedate the year 4000 B.C., since it is impossible to account for the conditions found, on any other basis.³ What, then, was the date of the flood?

¹ See *Bibliotheca Sacra*, vol. lxiv. pp. 149 ff.

² See *Ibid.*, vol. lxiii. pp. 510 ff.

³ See Clay, *l. c.*, pp. 19 ff., 138.

Many replies to this question have been given ; but it is doubtful whether any of them constitute an answer. The evidence bearing on the subject deserves a separate treatment, and certain neglected elements require recognition. They will receive it in the argument that is to follow.

In the meantime, let the following facts be remembered. Difficulties there must be ; but there is no need of exaggerating them. The divinity of Christ is a difficulty ; but so is radium, which seems to defy all the known laws of nature. What radium is to all other material substances, Christ was to other men. That should suffice. As to the supposition that the Bible story of the flood includes two separate accounts, as set forth in the two-document theory, — a thing which may trouble some, — little need be said. According to Exodus xviii., Moses appointed subordinate judges. They must have had a written document to consult ; for he could not attend personally to all their questions about the law, which they had to know to do their work. In Exodus xxviii., the consecration of Aaron and his sons to the priesthood appears. They too needed a written authority, and there is no question but that Moses could write. Two documents, both prepared by Moses, are thus provided for. They would naturally differ somewhat, and in time would tend to be united into one. This simple supposition, which no one seems to have even thought of, appears to meet all the difficulties, including those of the critics themselves ; for the same historical setting would serve for both sets of laws with slight variations, and there would be no longer any conflicting earmarks of style to be laid at the door of imaginary redactors.

CHAPTER IV.

THE DATE.

GEOLOGISTS have often been prodigal of time, and some of them have carried their prodigality to excess. This is the more surprising, when the known and visible effects of erosion during the past twenty-five hundred years are considered; for it is practically certain that nature's destructive agencies are now far milder than they have been in former eras. Incidentally, the Age of Man has been made unduly long. Other scholars, relying upon insufficient data, have made it unduly short. The date of the flood, being made to correspond, has been placed by the latter at a time entirely too recent to accord with the requirements of Geology, while geologists — if they have admitted the possibility of a deluge at all — have pushed it back to a time inordinately remote.

It is not an easy matter to determine; to settle it beyond dispute is out of the question; and yet the time may come when it will no longer be of its present doubtful character. A compromise may make this possible; but it must have a due regard for all the elements in the problem. The geological estimates vary greatly. The most conservative is that of Dr. Wright, who, in deference to his colleagues, makes an allowance of about three thousand years in addition to the time required by his own careful computations. He accordingly places the flood

at about 8000 B.C., a comparatively recent date, when other geological views are considered.

The data used by Dr. Wright were gathered at the Niagara River and in the upper Mississippi basin near Minneapolis. The Falls of St. Anthony, like those of Niagara, have eroded a gorge about seven miles in length since the close of the Glacial Epoch, or since the retirement of the ice which dammed the old river bed so effectually with its *débris* that a new passageway had to be cut by the stream. It is supposed that this latter event marked the end of the epoch; but that was apparently the time of the flood, and the problem has therefore resolved itself into the question How long did it take to erode those gorges? Ancient maps and surveys of known date make it clear that the rate of erosion for each has been approximately five feet a year, or about a mile in a thousand years, if the rate has remained constant. The date required would thus be about 5000 B.C., or possibly 6000 B.C., if allowance is made for the odd feet in a mile.

To so late a date geologists object, because it does not harmonize with their theories concerning geological time. In support of their contention, they point to the evidence, in the case of Niagara, of an ancient drainage of the Erie-Ontario depression, *via* the Mohawk River or some other stream, before the final disappearance of the glacial ice; and they would therefore add thousands of years to the time required for the erosion of the seven miles of channel by placing the end of the Glacial Epoch just that much earlier. But there are reasons for taking a view diametrically opposite to this and reducing the figures by at least a thousand years.

The periods occupied by these other methods of drainage are confessedly uncertain; and, on their own showing, they were too early to affect the date sought, since no ice barrier

of the kind they postulate can have existed after the flood to hold back or turn aside the drainage of the Erie-Ontario basin. The Mohawk route ¹ must therefore antedate the close of the era, as must also every other in all probability except that of the Niagara River, which was made available only after the melting of the ice had opened the Mohawk route and greatly lowered the water in the basin. But if any part of the present Niagara gorge was ever available for drainage purposes before the final destruction of the ice, the end of the era and the date of the deluge must be placed proportionally later, since some erosion must have taken place whenever any drainage by that route was rendered possible. But there are other and more important elements to be considered.

The amount of water passing through a given channel determines the amount of erosion accomplished in a given time. On this all are agreed. Now, it is certain that the territory occupied by the United States was for centuries after the Glacial Epoch the home of vast inland lakes, beside which, by comparison, the "great lakes" of our own day seem insignificant. But such enormous sheets of water, even if the sun could exert but half its present influence for lack of a clear sky, would lead inevitably to an excessive evaporation, which would in turn render the precipitation far greater than anything now known in the same regions. Swollen streams would thus become a necessity to take care of the rainfall, and, indeed, the very lakes themselves would involve such streams as an indispensable part of their being. It is therefore to be presumed that not only the Niagara but also the Mississippi gorge carried a greater volume of water at some time in its history than that now in evidence.

¹ See Wright, *Man and the Glacial Period*, pp. 92 ff., 220 ff., 339; *Scientific Confirmations of Old Testament History*, pp. 229 f., 330 f.

The two gorges have another common characteristic, which has apparently been overlooked, as a factor in the problem, by all those using their erosion as a means of computing time; namely, their relative width, and that of their channels, in the old and new portions. Dr. Wright has incidentally called attention to this feature,¹ and it is strongly marked in both instances.² That this element is of vital importance cannot be doubted, much less questioned, when it is remembered that the narrowing of a channel always inevitably deepens to a proportional degree the volume it must carry to accommodate a given amount of water, though the speed of the current must also be taken into the account. As increased speed, however, would more than make up for any diminution of volume occasioned by it, it may be ignored in this connection.

It is now argued respecting the Mississippi that the drainage below the Falls of St. Anthony has improved with the years; that the erosion has therefore been more rapid in recent centuries than it was in the early days; and that, on this account, more time must be allowed for the results obtained than present rates would signify. This reasoning is clearly fallacious on several grounds. The old gorge, now partially filled with glacial *débris*, lies to the west of the modern one. It is from two to eight miles in width between the faces of the bluffs on either side, and its buried channel is of a width to correspond. The new gorge is a scant quarter of a mile in width, and its bluffs are high and steep. Its channel is proportionally narrow.

The exact history of the falls does not seem to have been worked out; but the gradient is not affected thereby, and the

¹See *Bibliotheca Sacra*, vol. xli. pp. 369 ff., and *Man and the Glacial Period*, pp. 208 ff., 333 ff.

²See *l. c.*, and *Cent. Dict.*, vol. x. map 13.

water must have descended just so far to reach the ancient channel at the point where the Mississippi resumed its original course. It may have made the descent by small separate falls, or by rapids — continuous or otherwise, — or by a combination of falls and rapids, or by a succession of falls similar to those now found in Minneapolis. The chances are that changes, more or less marked, have taken place in the character of the descent with the lapse of the centuries. Its total amount, however, is not great, and the possible variations are therefore somewhat limited.

The new gorge ends not far beyond the present location of the falls; and the Mississippi, both above and below it, appears to have had a greater width at the start than the stream in the new gorge ever attained. It must have corresponded, in fact, to the former channel in the broad ravine to the west, now choked with glacial *débris*. This very obstruction in its pathway was the thing which caused the river to abandon its ancient bed and cut a new channel for itself in the neighborhood. But if the river had a greater width both above and below the new gorge, it must have had a greater carrying capacity also. From this conclusion there is no escape; and, furthermore, in the beginning there was no channel at all for some miles just after the completion of the damming process. The water must have been held back, therefore, until it had acquired sufficient "head" to force its way through some weak spot in the bank and begin the cutting of a new excavation.

Now, it is not to be supposed that the glacial *débris* was entirely confined within the narrow limits of the ancient gorge. Glacial ice is not so particular as that; and it is more than likely that loose material was to be found on the river banks also, through which the water was forced to cut its way. In

the erosion that followed, this material was a factor. Doubtless a small and narrow stream began at first to trickle between the rocks where the least resistance was offered to its passage; but it must have gathered headway as it went, and a channel would thus be eroded with increasing rapidity. Stones and loose gravel on the sides were doubtless undermined and carried onward by the growing stream, and the loose earth beneath soon showed the effects of their action; for a deep and narrow channel was evidently cut to bed-rock and cut quickly. Erosion in this latter material has resulted in the present falls.

The very narrowness of the modern gorge and channel shows that they were excavated with such rapidity that the waters were accommodated by the increasing depth and were not forced to spread outward to any great extent as they grew in volume with the opening of a passageway. The size of the ancient gorge testifies to vast quantities of water at some stage in the river's history, and it is not to be supposed that the present volume of the Mississippi was at once attained when the Glacial Epoch ended and the ice disappeared. For many ages the flow must have been far greater than anything now known there, and the erosion could not fail to correspond. The glacial *débris* was certainly not exhausted by the first onset of the river, and for many decades afterward material of this kind must have continued in decreasing quantities to furnish its aid in the erosion that was going on in the new channel. The conclusion is inevitable. Present erosion is less rapid in its action than was that of the early days after the formation of the new gorge was started; and the year 5000 B.C. is therefore too early rather than too late a date for the beginning of the backward trend of the falls, which must have varied in a corresponding ratio.

But that is not all. The ancient bed below the new gorge — and above it — was both wider and deeper than the new channel that was forming, and this peculiarity must be allowed for. Both the speed of the stream and its erosive power would be checked thereby. The old bed, then, has suffered comparatively little change in the intervening ages, which can only mean that either the gradient of the new gorge or the height of the falls (or both) has been steadily diminishing from the start, so that the erosive power of the river has suffered diminution from this cause also, as has the speed of the backward movement of the falls themselves.

The new channel could not be made relatively deeper, as the two levels approached each other, without producing some such result, and this certainly had its influence. The deepening, moreover, instead of constantly increasing the average amount of water passing through the cut, would ultimately tend to diminish it, because the gorge itself would be affected so that less and less water would be held back in times of freshet in the broader parts of the ancient valley above. With each increasing foot of depth and breadth, the gorge could carry more and more water, and in times of flood the bluffs on either side and the bottom of the valley would be likely to suffer far more than the channel itself. The final outcome would be a gradual diminution in the amount of erosion in the channel proper, as manifested at the falls, because the gorge, as it became wider and deeper, would ultimately permit the excess of water to escape immediately, when the river overflowed its banks, instead of by degrees.

Improvement in the drainage is therefore no argument for an increase in the speed of erosion during recent centuries; for it has probably led to a reduction in the amount of water available for the purpose, during a part of the year at least,

provided a general average is struck. When the gorge was but little wider than the channel, practically all the water had to go over the falls in time of freshet; and the erosion must have been enormous. As the gorge widened, the overflow must have spread outward beyond the falls more and more in time of flood, and less water proportionally would then go over the brink, although a horseshoe effect would still be produced at its location. In time, the river bed would become deep enough to make overflows rare, and the amount of water available for erosion would thus be increased somewhat; but it would still be less, on the average, than it was under earlier conditions with a greater rainfall, and the slight increase of erosion that might follow, would be an actual diminution in comparison with earlier amounts.

If the total volume of water could have been confined to the new channel at all times, the diminution in the speed of erosion would have been continuous. As it was, the loss of speed must have been quite marked for some ages; but the rate of erosion would finally become fairly stationary, since any increase in carrying capacity would be fully offset, if it was not exceeded, by losses in the height of the falls and in the rapidity of the current and the amount of water available from precipitation, although temporary increases might sometimes occur from various causes. In the long run, the chances are that the rate of erosion would continue to diminish, on the whole, though it would do so very slowly when present conditions were attained. That the waters of the river have not always been confined to the channel, the gorge and its bluffs bear silent witness, and they testify to the probable accuracy of the above diagnosis.

At Niagara similar conditions prevailed; but the river was affected in a somewhat different way. The channel from the

falls to the whirlpool rapids is not wholly new ; for there is an old outlet at the latter point. It is now filled with glacial *débris*, though it was once fairly wide and deep. Below the whirlpool, the gorge is entirely new, and, as far as Queenston, it represents an erosion produced by falls since the retirement of the ice or since the close of the Glacial Epoch. The escarpment ends at Queenston, and, from that point to the whirlpool above, it must have been cut away by the waters of the river. No falls were possible below the escarpment, so that this part of the problem is fairly well defined.

Several contingencies need to be allowed for. To begin with, the filling of the old outlet meant the complete damming of the river ; for the escarpment was then unbroken by the present gorge. The water was thus held back and driven up stream, until it had risen to a point where it could find a way of escape. Whatever the location of the present falls may have been at that time, they must have occupied a point at least as far up stream as the whirlpool ; and whatever channel may have existed between it and them must have been turned into a basin which was also filled with glacial *débris*.

When a new channel had been cut and the escarpment had been sufficiently eroded to allow the river to assume a normal condition, there may have been two separate falls with a space of several miles between them, — an insignificant one above the present whirlpool and a huge one below it. The erosive power of each depended upon the speed of the current as well as upon the amount of water passing over its brink ; and, while the greater part of the erosion must have been at the lower cataract, the probable existence of the other fall complicates the problem. At the whirlpool also, in the rear of the escarpment, some friction must have been developed by the gradual loosening of the *débris* that filled the ancient channel. As this

passed down stream it added its influence to the destruction of the barrier. This must have been small; but it helped, and the net result in the end was a hastening of the destruction of the escarpment. The gorge below the whirlpool was thus gradually formed and as it neared completion the lower falls began to disappear, the gorge above them began to be drained, and the present falls began to assume their modern form, or to resume their ancient one. Erosion at their location was then restored to its former potency and began to go on as of yore.

Just where the upper falls were situated, when the lower ones gradually ceased to be, is not clear; but it is evident that they must have been further up-stream than they were at the time the old channel was obstructed. They were then plainly at, or above, the whirlpool rapids; for, otherwise, there could have been no ancient gorge to be filled with glacial *débris* at a point just beyond. This part of the escarpment had been eroded in past ages; but the cut was now blocked effectually with material left by the ice. The river was thus forced to provide itself with a new channel, and it did so, taking a course approximately at right angles to its former one. This would seem to indicate that either the glacial deposit at this point was once much greater than it is at present and that the new channel was first opened through the loose surface material left by the ice, or else that the initial deposit was reinforced by some other means. Both contingencies may be true; but, in either case, glacial *débris* probably did its part as a scouring agent in the process of eroding the escarpment. That such material greatly hastened the completion of the channel-cutting below the point of obstruction can hardly be doubted; for it must have been carried into the stream in vast quantities for many years. In this respect the history of the Niagara

gorge strongly resembles that already outlined for the Mississippi one, and their beginnings were doubtless parallel also.

It must now be clear that some allowance will need to be made for these other factors, if the rate of erosion at Niagara Falls is to serve as a basis for computing time since the Glacial Epoch. And with them must be placed the element of comparative width, which has already been referred to in this connection. In turning from the falls to look at the gorge below, almost any one would be struck with the remarkable contraction which it shows in the matter of the relative width of the falls and the lower rapids. Some allowance must be made for the slope in the banks and for the shelf that runs along the American side; but after this has been done the gorge is still far narrower than the river above the falls is, to say nothing of the perimeter of the falls themselves. They doubtless had a horseshoe shape from the start; but even with that concession, they would have to be moved but a scant half mile down stream to be greatly contracted in extent, as compared with their present dimensions. Except at the whirlpool itself, the gorge remains comparatively narrow throughout its entire length.¹

The conclusion is obvious. The ancient falls were much restricted in width, if the modern ones are made the standard. And if the amount of water was anything like the present supply, the erosion was perhaps twice as great as it is in our day, since approximately double the amount now going over the brink at any given spot would have to be accommodated at the place corresponding to it, unless the level of the lakes was lowered. The water supply could therefore be greatly dimin-

¹ See Cent. Dict., vol. x. map 13. The contrast there shown far exceeds anything here claimed; but the channel is mapped, not the gorge. Erosion on the Canadian side has long exceeded that on the American side, and the effect of this must be allowed for.

ished without reducing the rate of erosion that is commonly used in these time calculations, and this diminished supply could continue for the greater part of the entire period without making it longer than the time now estimated. As the precipitation was undoubtedly greater than it is at present, during a part of the time, and there is no likelihood that it was ever less, it follows that the period allowed for erosion is too long to accord with the facts. It should therefore be shortened, although there is danger of going to the other extreme and concluding that the time has been much shorter than it has in reality.

The probabilities are that the actual location of the ancient falls at the time the river was dammed was at or very near the spot now occupied by the whirlpool; for it seems likely that the *débris* would choke the gorge for its entire length. For this reason, no deduction can be made in the length of the gorge to be eroded; and it will not do to allow too much for the erosive action above the lower cataract during the period of its existence. At the beginning, this action must have been very slight indeed, although the time came when it counted for something in the aggregate. It was intensified as the lower channel deepened; but this must have been an extremely slow process, and it is likely that some diminution would occur in the rate of erosion produced by the lower falls as they diminished in height.

These are small factors; but they affect final results, and they must therefore be considered. Possible differences in methods of drainage should also be allowed for, since there may have been slight changes of elevation accompanied by temporary diversions of the waters of the lakes¹ during the period under discussion. The remarkable resistance shown by the

¹ Cf. Scientific Confirmations of Old Testament History, p. 402.

débris at the whirlpool rapids argues that some other obstacle may have been met with at this point by the river, when it was seeking an outlet for its empounded waters. The edge of a field of ice would furnish such an obstacle, and it would make the sudden turning of the river easily comprehensible; but an explanation of that character projects the erosion backward into the Ice Age, unless it is assumed that some fortuitous berg was stranded at this point by the retiring flood and left to waste away by degrees. Such an event was a possible, but it was not a probable, cause of the river's action; and, if there was no ice, there was probably a greater accumulation of *débris*, which has been gradually reduced to its present amount.

The river, then, on such a basis, must have first plowed its way through loose material, which served the purpose of hastening the formation of a channel in the ledge, when once the earth had been washed away and the grinding that results from rocks and gravel in a stream had been made possible. This would be likely to shorten the period required; but the presence of ice might do the same, since more or less of the same material would still be available. If glacial ice is insisted on, the erosion began before the time assigned, and the date of the deluge must be made more modern to correspond therewith. In all this there is scant comfort for those geologists who would project the Glacial Epoch backward to an era many thousands of years ago.

Climatic changes always lag behind their causes. The coldest weather of the northern winter is apt to occur some weeks later than the winter solstice, when the sun is growing warmer with the lengthening of the days. In like manner, the greatest heat of the summer months is wont to be felt when the days have grown perceptibly shorter. It therefore seems likely that

the full effect of the reversal of the present relations of Perihelion and Aphelion, which took place something over ten millenniums ago, was not felt for several centuries in the Northern Hemisphere, with which the argument has especially to do. But if this is so, it took a long time for the winters to attain to their maximum length and a longer one for the accumulations of ice and snow — made possible by the enveloping clouds and the chilling summer fogs that prevented their destruction — to reach their maximum extent. That event, therefore, can hardly be placed earlier than the year 8000 B.C.

Then came the prolonged struggle between the snow and the sun, as the cloud caps shrunk in extent and the sun shone in his strength during the short Perihelion summers; for they only occupied the time taken in traversing one end of the earth's elliptical orbit. The wavering glaciation, with its alternately advancing and retreating ice fields was the result; but the glaciation persisted and even increased at its main centers, until the ice was pressed outward in all directions with increasing speed and sufficient force to move great boulders long distances and produce the other well-known effects that now disclose its history. Mighty lakes, some of which were due to ice dams, furnished a broad expanse at the southern limits of the glaciated areas, from which to replenish by evaporation the nimbus clouds as fast as they were dispersed in the form of rain. Fog, too, did its part, as it does to-day in the Perihelion summers of Antarctic regions, where zero weather in mid-summer is no novelty.

Conditions like these would be likely to persist, until some force that was capable of destroying such enormous glaciers in their entirety made its appearance; and it may be inferred that they did persist for ages, or until the resisting power of the continents was overcome by the enormous pressure of the

concentrated glacial ice, now a mile or two in depth over a large part of the affected areas. Submergence followed, and submergence is an adequate cause for the effects produced. No other adequate cause has been suggested, and no other need be looked for, since it is not probable that any other can ever be found. When the time was ripe, the lands sank under their burden, the ice was destroyed, its place was taken by broad temperate regions bathed in sunlight, and a new era was begun — an era in which men might attain to their greatest and best development. In that era we are living, and it has not been unduly long.

Geologists have been led to infer that vast changes took place in the glaciated areas and that these must have required untold thousands of years; but nature is not always uniform in her methods of procedure, as recent earthquakes testify. She can and does act suddenly at times, and she did so when the ice had accomplished its purpose. That the changes were great in the interim in the limits of glaciation, there can be no question in the face of the evidence adduced; but, when the surprising alterations that have taken place in the Muir Glacier within the past century are considered,¹ the doctrine that such variations in extent and contour require unlimited time, becomes extremely doubtful, to say the least. Attention has already been called to the fact that Astronomy forbids any such teaching,— it does so on the basis of known rates of cooling,— and it may therefore be assumed that four thousand years is ample time for the changes warranted by the evidence.

This would place the flood at about 4000 B.C., a date with which Chinese tradition is said to be in harmony.² At that

¹ See *Records of the Past*, vol. viii. pp. 113 ff.

² See Urquhart's *New Biblical Guide*, vol. i. p. 272. It is worthy of note that in this tradition Fuh-he escapes with his three sons and three daughters, while the rest of the human race perishes. This

time writing was certainly known and a high civilization prevailed both in Babylonia and Egypt. It is not unlikely that similar conditions were to be found in China also and possibly elsewhere; for recent discoveries in the caves of France would seem to indicate a great antiquity for the art of weaving and a hitherto unsuspected amount of progress on the part of Palaeolithic man.¹ The construction of the ark was therefore well within the bounds of possibility, and this part of the Bible narrative is no myth.

Dates in the early history of ancient nations are still uncertain; but evidence of a decided break in the continuity of their rulers and of the people also, for that matter, before the dawn of reliable history, is not lacking, in more instances than one. Somewhere in the neighborhood of 4000 B.C. it now appears likely that the flood occurred; for at about that time all the intricate conditions in which the event is enmeshed seem possible of fulfilment. The Chinese tradition may therefore be correct, and the Assyrian records may be right in referring to sacred documents or rather inscriptions of a contemporary date. If they are, it is no mere coincidence that the Genesis account of the deluge reads like the tale of an eye-witness; for Noah may have kept a record, and this may have been religiously preserved for many generations, until it came into the hands of Ruel, the priest of Midian, who was a descendant of Abraham, and whose daughter Zipporah became Moses' wife.² Through her the story may have come into his possession and been given its present literary form. More re-looks like the story of Noah in Chinese garb, and it may be that it is: for the Chinese may have received the tale at a very early period when it was still possible to place the date with approximate accuracy, and they may have preserved it with characteristic fidelity.

¹ See *Bibliotheca Sacra*, vol. lxiv. pp. 526 f.

² See Gen. xxv. 2; 1 Chron. i. 32; and Ex. ii. 16-22.

markable things have happened, and truth is ever stranger than fiction.

A word further should be said of the climatic changes, mentioned above, as an accompaniment of the altered conditions due to the flood. The submerged areas rose again, but they never attained to their old-time level. These portions of the continents remained comparatively low, and corresponding portions of the oceanic islands and of the ocean floor remained comparatively high, the net result being a higher general sea level and a lower general altitude of the land. Continental areas were thus reduced, while sea areas were greatly extended, as has been stated; but at this point another element appears. In calculating the power of the tidal waves which constituted the main features of the flood, allowance had to be made for the molten lava, boiling mud, and superheated steam, that were forced into the ocean from beneath it, in the course of the cataclysm. Vast quantities of heat were absorbed therefrom by the waters of the sea; but the melting ice took care of most of it in the aftermath, and a balance was thus struck which served to equalize climatic conditions everywhere. The results attained have persisted, and man has been the gainer.

It must not be supposed that these effects took place immediately; for they did not. Much of the glacial ice was speedily melted; but many huge bergs and extensive floes were left, because they were too large to yield at once to the destructive agencies, great as those were which assailed them. Some were undoubtedly swept out to sea, where they continued to drift for many decades after the ebb and flow of the flood had ceased; but in time they completely disappeared. More were probably stranded on the land and left there to slowly melt away. To such floes as these may possibly be attributed many

of the strange and puzzling geological combinations that have long baffled the ingenuity of scientists in the efforts they have made to explain them. The floes, if they were the agency used, certainly served their purpose well in mixing various elements of a diverse character. They also affected the climate and delayed the final triumph of the sun.

Backward springs, tardy summers, fields of ice that lasted far longer than they should on the surface of the vast inland lakes, ice dams in the fastnesses of the mountains that refused to yield,—some of them lasted for years because of the protecting silt washed over them,—temporary lakes due to these dams, and probably other similar results, were all the indirect outcome of the presence of these stranded masses of ice in various extended areas. In time these also disappeared, and modern conditions began to prevail. Looked at from this side, 4000 B.C. again seems like a probable date for the end of the Ice Age. The earth had now shifted its position so that Perihelion and Aphelion were beginning to occupy the months between the winter and summer seasons, and in the Northern Hemisphere, as well as in the Southern, the spring and fall were the parts of the year most affected, the one season being shortened somewhat and the other lengthened. If the flood occurred under these conditions, they were certainly favorable for an outcome like that which must have taken place.

As to the repopling of the Euphrates valley and the neighboring lands, it will need but a few figures to show that a scant four hundred years would be sufficient to provide a population of over four million persons, if, starting with Noah's family of eight and excluding all other possible sources of supply, the number of people in the world were to double itself but once in twenty years, a thing which was certainly possible in

those early days of large families and long-lived men. But if the population doubled itself only once in thirty-three years, the lapse of five centuries must have produced over one hundred thousand souls. Under favorable conditions, it may have been able in those days to double itself as often as once in ten years; and, on that basis, less than a century and three quarters would be sufficient to produce over half a million people. Such possibilities, to say nothing of the world's experience during the past five hundred years, should give pause to the men who so readily postulate "eons of time" for past eras and events. The truth is that "the imagination is a forward delusive faculty ever obtruding beyond its sphere." It should be held in check, unless it is supported by reliable data or known facts.

Time has not been limitless, so far as this present world is concerned, and it will not be. The brief and temporary character of all things mundane must be conceded, in the light of what has been discovered, and it behooves us to be modest in our estimates of past ages. The flood, therefore, was not so remote an event as some would have us believe, nor yet was it so recent as many have taught. The well-known habit of Orientals of leaving out unimportant generations and counting descendants as sons, was common among the Hebrews, as unmistakable examples in the historical records of the Bible testify. No dependence can be placed, therefore, on Ussher's chronology.¹ It is entirely unreliable, and the date of the flood must be obtained in other ways, if it is obtained at all.

¹ See Wright, *Scientific Confirmations of Old Testament History*, pp. 189 ff., or *Bibliotheca Sacra*, vol. lix. 288 ff. The Aryans had this habit, and the ramifications of meaning embodied in the etymological relatives of the English word "nepotism" bear witness to the fact.

It remains to mention certain other features, particularly some connected with the inland seas and lakes which may have been affected by the breaking up of the ice pack or the submergence of the continents. That extensive areas of North America were flooded long after the disappearance of the ice has already been stated. This is conceded by all, and its effects have been fairly well agreed upon. Like conditions must have obtained elsewhere, notably in Asia, the gradual desiccation of a large section of which is reflected in the Vedic literature. That many of these ancient lake beds have been found to contain salt deposits at their bottom may be explained by the admixture of sea water due to the deluge, and the influence of the melting ice may be traced in the relative proportions of the salt in different basins. Concentration gradually led to saline lakes of a smaller size; then came ponds; then, salt marshes; and finally deposits of salt. The Aral Sea has remained in a condition resembling that of these ancient lakes; but the Caspian seems to have received additional accretions of salt during the high water stage of the oceans, when it was directly connected with the Mediterranean *via* the Black Sea.¹ Neither sea is very saline; and it has been

¹The high water of those post-glacial days may have another possible tale to tell; for, as was suggested in the London Times of February 19, 1909, the remarkable discoveries recently made in Crete may point to the lost Atlantis so graphically pictured in Plato's *Timaeus*. The topography and political requirements seem to be fulfilled by this ancient kingdom, and the evidences of its undoing are still plainly traceable. The story of the priest of Sais, according to which Athens conquered Atlantis only to be overwhelmed with it by the encroaching sea, may come nearer to fact than to fiction, provided it can be shown that ancient geographical ideas were somewhat confused with reference to the location of the Pillars of Hercules. This is not impossible. As to the mud banks dangerous to ships, which resulted from the overwhelming of Atlantis, it may be, as has been suggested, that they confused the Syrtes with the lost country; but it seems more likely that there

inferred that neither has been long enough enclosed to gather and concentrate a great amount of salt, as the Dead Sea and Great Salt Lake are supposed to have done. The ordinary assumption is that they have accumulated salt with the help of the streams flowing into them; but a different hypothesis will be offered below. It will not be any harder to believe than is the present remarkable theory.

Lake Baikal is of importance; for it shows signs of some recent great upheaval, or some mighty earth movement, such as has been postulated as one of the incidents of the flood. Its enormous chasm may have been affected in some way at the time of that event; and, if it was, its remarkable depth may be due to some readjustment of land surfaces which allowed its bottom to settle below its ancient level. Such glacial *débris* as may have existed in that cold and forbidding region may thus have been swallowed up in the depths of the lake, leaving no traces behind it to tell the story.

While it had no glacial elements to contend with, the Dead Sea may have resembled Lake Baikal in other respects so far as its genesis is concerned. It lies in an earthquake region which has suffered extensively in the past, and it occupies the lowest part of a great cleft, a thousand miles or more in length, which is plainly the result of some convulsion of nature. Its greatest depth is about thirteen hundred feet, while the greatest depth of Lake Baikal is more than four thousand; but its area is small in comparison with Lake Baikal's four may have been such places in the lower parts of Orete, when the sea level was at its maximum height of possibly two hundred and fifty feet above tide water as the ocean is at present. It appears to be safe to assume, as has been done, that the power of the supposed fabled land may have greatly exalted the ideas of other nations with respect to its size, and that feature of the tale may therefore be less important than it looks.

hundred miles of length and thirty miles of width. On neither has the silt of modern ages made any apparent impression; and either their original depth must have been excessively great or else the clefts which they occupy are geologically very recent. As was implied above, this may point to changes in them at the time of the flood, and it may even indicate that that event was not very remote.

Lake Baikal has an outlet to the sea, and its waters are fresh. The Dead Sea is land-locked and exceedingly salt. It seems likely that this feature is in part the result of a gradual concentration of the vast quantity of salt water that must have been left by the flood in the great cleft of which the Dead Sea is a portion; for there are evidences that this cleft was once filled with water to the brim. If the Dead Sea really is the residuum of such an inheritance from the flood, its saline character is not hard to understand, and the salt bluffs on its eastern shore seem less remarkable. On any other basis, the presence of so much salt, apparently crystallized out of the sea itself, is not easy of comprehension. Some salt has undoubtedly been contributed by drainage; but the proportion must be very small and hardly worth considering, unless natural salt deposits not due to the presence of sea water have added their quota to the sum total through some agency in the past. The salt impregnated sands of the shores are not to be overlooked, and they point in the direction indicated above.¹

¹ It may be possible that the rock salt of the bluffs had some other origin than that usually supposed and that it furnished the source of supply for the sea instead of being derived from its waters. The latter contingency, however, remains,—attractive as the former supposition plainly is, though where else the salt could come from is a puzzle. If it was there before the flood, the sand and gravel overlying it may go back to that event and not be the result of excessive rains. See below. Also Wright, *Scientific Aspects of Christian Evidences*, p. 126.

A similar solution may be postulated for our own Great Salt Lake; for it may be but the impounded dregs of the huge tidal wave that must have invaded this part of the great western plains from the south, filling the basin of the Salton Sea and covering everything but the mountains with water. There could have been no admixture of ice until the northern limits of the plains were reached. There the ice was encountered, and the water was therefore freshened. At the close of the disturbance, an immense body of water was left, with a shore line nearly a thousand feet above the present level of Great Salt Lake. It included Lake Sevier, which is also salt. Fresh water shells are found along this shore line; but the water was probably brackish and therefore sufficiently saline to account for the present character of the lake.¹

As to the cause of the ocean's saltness, it seems absurd to suppose that the rivers have washed enough salt into the sea to furnish its supply. Ocean areas far exceed those of the land, and the rivers cover but an insignificant fraction of the latter's surface. If they can find salt to wash into the sea, is it reasonable to suppose that the ocean can find none beyond what they contribute? Mines of rock salt hard enough to permit beautiful grottoes to be carved out of the salt itself are found in Europe, and other salt mines occur elsewhere. It is therefore hardly to be supposed that the entire ocean floor escaped all such formations. But if it did not, the river theory falls to the ground. So does the absurd notion that the ocean began as fresh water. It began as hot water; but wherever

¹ It may not be without significance that a salt mine in Southern Louisiana, discovered in 1861 beneath a drift mass sixteen feet or more in depth, was found to contain fossil remains of human beings, mastodons, mammoths, etc., together with pottery and stone implements. Here, again, both men and animals seem to have been overtaken by a common catastrophe.

sodium chloride came into existence in forming the earth's crust, there any contact with hot water, be it rain or running stream or stagnant pool or extensive sheet, meant a saline solution. Condensation after saturation meant crystallization, and many of the present salt formations undoubtedly had such an origin; but at the beginning of things at the time when chemical compounds were just coming into existence it is clear that some other process must have been available. Otherwise there would have been no salt. It is accordingly safe to infer that the ocean, on the basis of comparative opportunity, is not indebted to the rivers for its salt. The chances are thousands to one against such a contingency, and the ocean has probably been in contact with salt, either formed or forming, from the start, for such chemical compounds must have occurred in the very beginning.

It was postulated that the ocean was at a low level during the Ice Age, or at the beginning of the Quaternary Period when man was created. The Euphrates valley must therefore have been much higher, relatively speaking, than it is to-day, and the river must have flowed through a fertile plain where the Persian Gulf now lies. This plain may have been the Eden of Genesis, and its climate may have been ideal. It is now a region of excessive heat; but the change of relative levels, the sea being possibly seven hundred feet below its modern stage, because of depletions and a less uneven bed, with the protecting clouds, must have tempered the heat materially.

With the flood, the whole situation was changed. The level of the sea was greatly raised, and it continued for ages much higher than its modern norm. The lower part of the Euphrates valley was therefore flooded, and the Tigris and its sister stream were thus enabled to enter the Persian Gulf by sep-

arate mouths. This condition prevailed up to what may now be called historic times. Ur of the Chaldees, when Abram left it at about 2150 B.C., is said to have been a maritime city with a harbor and docks. Its location is now approximately a hundred and fifty miles inland. Silting up has gone on beneath the waves, the silt has been heaped up more or less by them, and accretions have been added from other sources; but, unless the land itself has been elevated, which is a remote contingency, the ocean must have been lowered to account for the facts. It is possible that both things have happened; but the chances are with the latter probability. These considerations furnish another strong presumptive argument for the accuracy of the hypothesis already outlined.

Changes of ocean level have certainly occurred, and there has been a reason for them. But if the causes that were operative during the Quaternary Period have been correctly outlined, it will hardly be possible to place the beginning of present high water conditions much earlier than about two thousand years before Abraham's day. The margin allowed by this period is ample apparently, and concessions could as well be made by reducing the time as by increasing it. Excavations at Nippur have disclosed extensive accumulations of *débris* antedating Sargon I., whose date was 3800 B.C. These deposits may have been a by-product of the flood. If they were, they are significant.

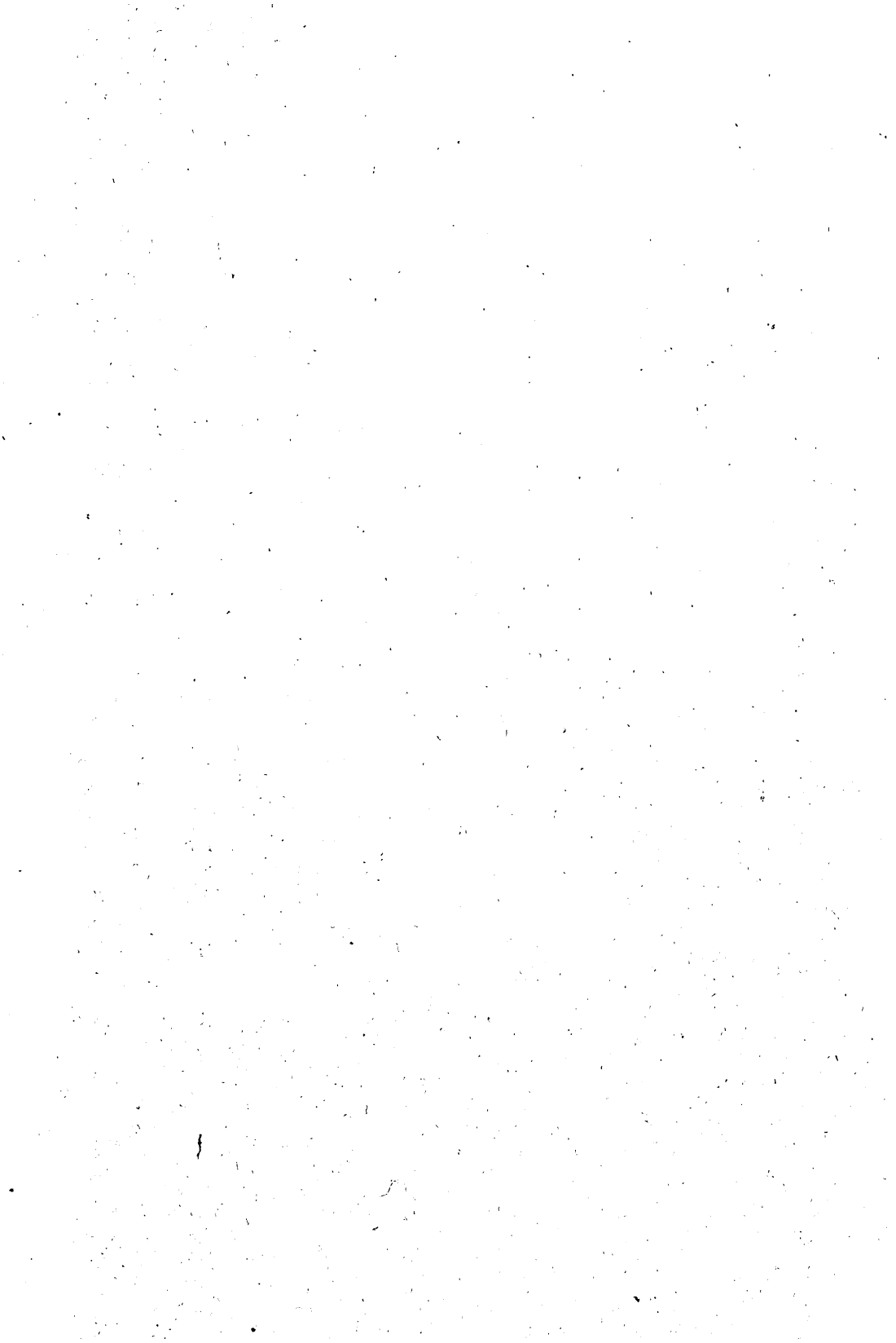
Much remains to be learned concerning the deluge; but the conviction is growing that a world catastrophe lies back of Noah's story.¹ His tale, despite its strange incidents and ap-

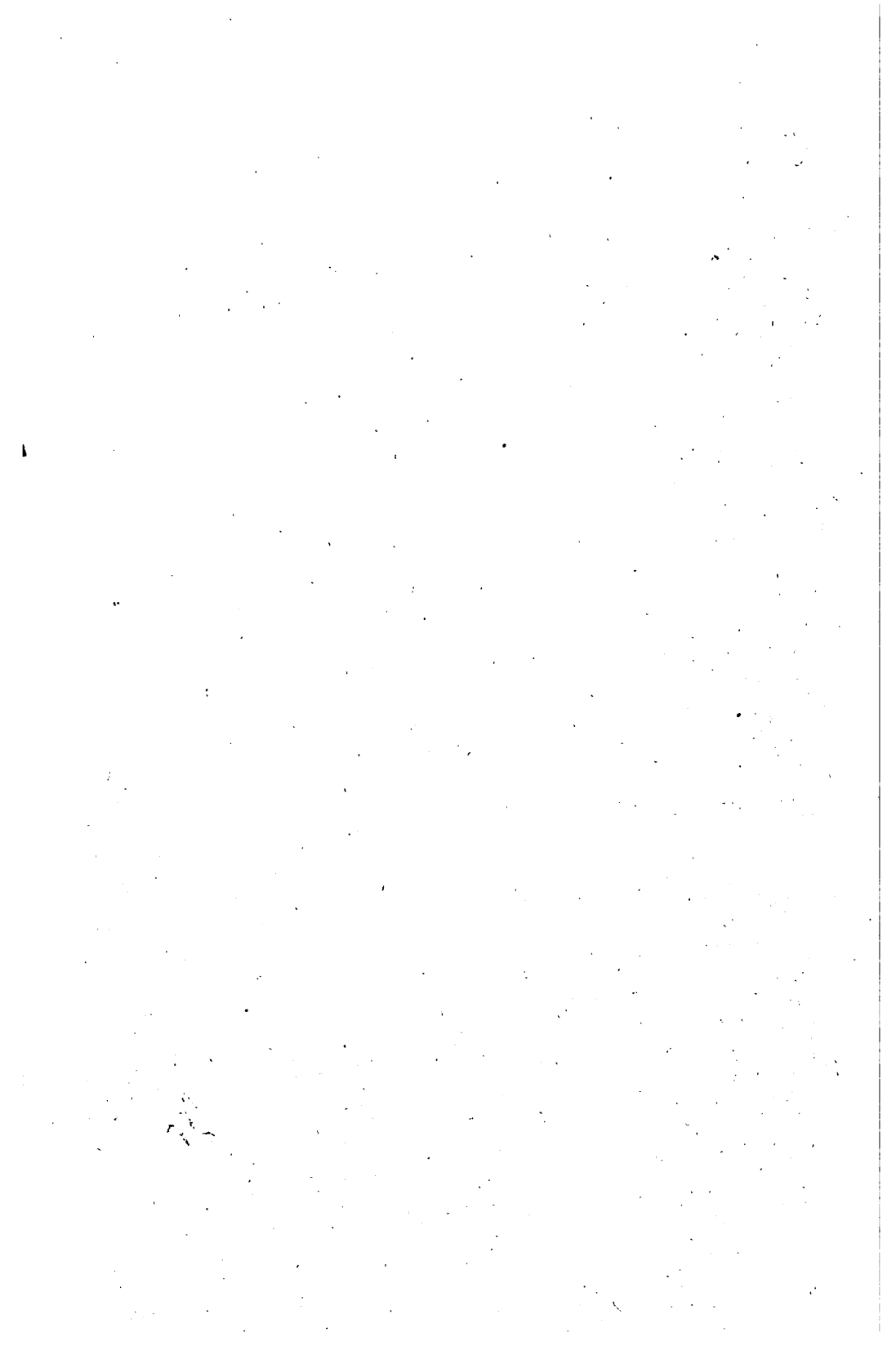
¹Those who are not accustomed to think clearly or to differentiate things that are associated but not alike, may find it hard to entertain the idea that the flood itself, though practically universal is not so described in the book of Genesis. Such persons fail to see, however, the difficulties besetting any other conclusion. Did Moses

parent defiance of natural law, is an accurate and vivid portrayal of actual events. No man would or could imagine such things with no experience to suggest them; and it is contrary to human nature to insert such details in a perfectly sober narrative, unless the truth demands it. Irrespective of the fact, then, that the account is found in the most remarkable and most trustworthy book of the ages, it is safe to infer that Noah had the experiences set forth in the Bible story. Truth is proverbially stranger than fiction, and he told things as they actually happened.¹

understand modern Geography? If he did not, how could he have included the entire world in his story? If he did so, the Bible is in conflict with some of the facts, and its veracity is impugned. Does such a condition tally with inspiration? Which horn of the dilemma shall be taken? A man ignorant of Geology might so describe certain fossil remains that a geologist would recognize them as the head and neck bones of an antediluvian Brontosaurus, a hideous creature resembling a sort of elephant with anterior and posterior elongations suggestive of the fabled sea serpent. He would view the fossils accordingly; but his informant would almost certainly describe them as the remains of a huge snake, though he might be accurate in his account of the bones as far as he went. It would be unreasonable to ask for more. Is it reasonable to make unnecessary demands on the extent of Moses' knowledge or on the doctrine of inspiration or on the completeness of a revelation for which there was no practical need?

¹ A slight error was made at the start in outlining the problem; for "highest mountains" should read, hills and mountains (third page top).









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